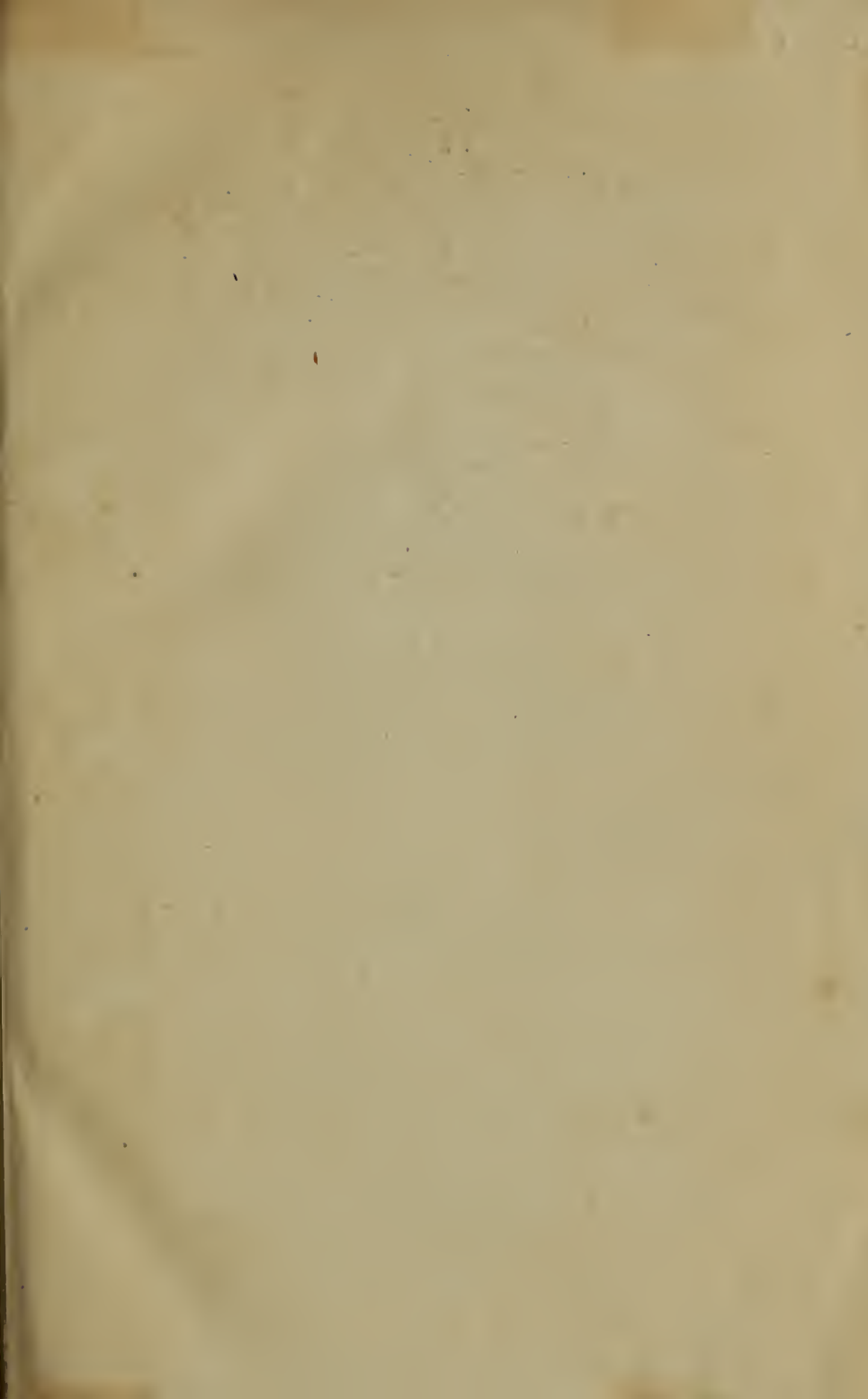
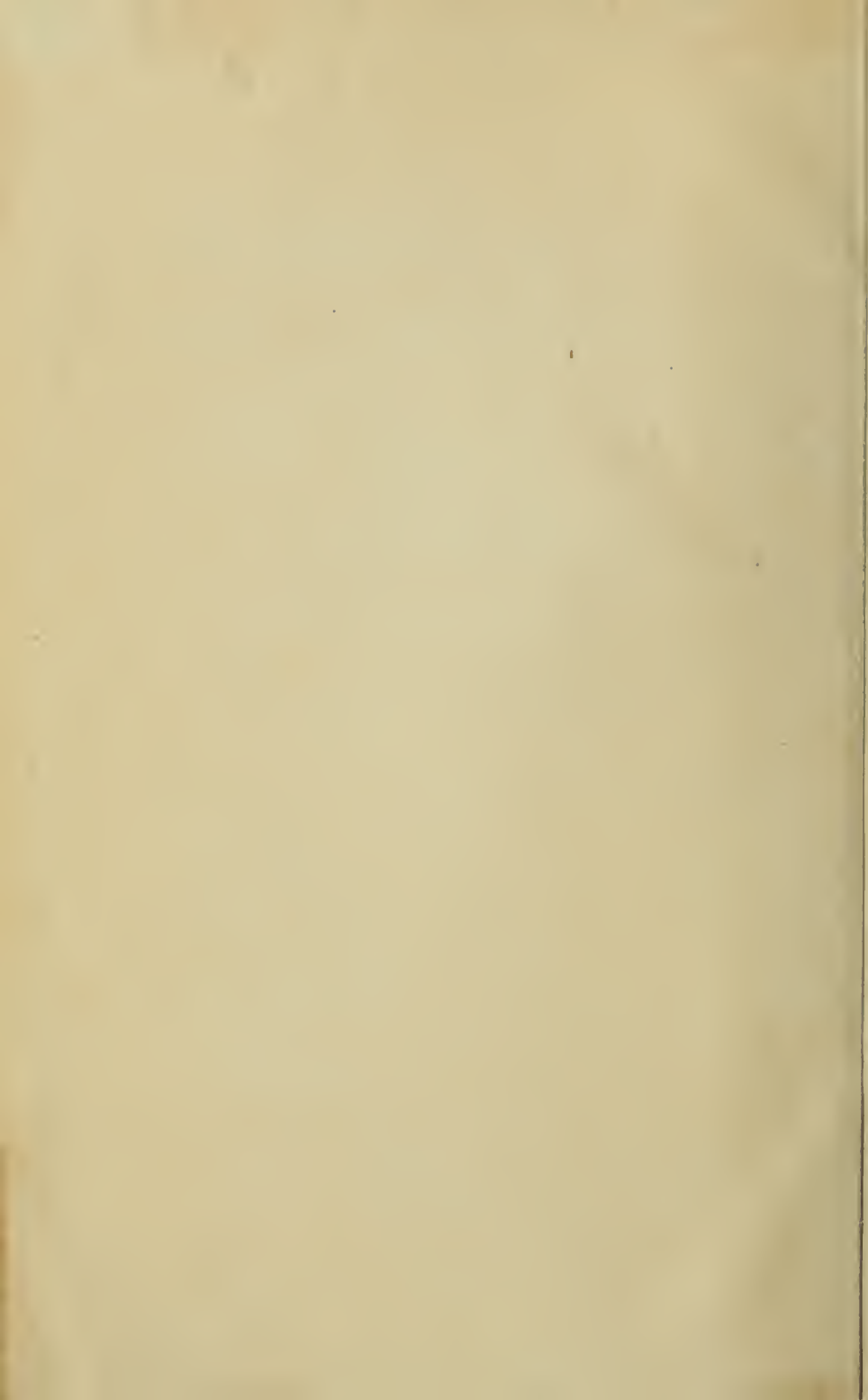




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21 May 1857







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JOURNAL

OF THE

FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA.

FOR THE PROMOTION OF THE MECHANIC ARTS.

DEVOTED TO

MECHANICAL AND PHYSICAL SCIENCE,

Civil Engineering, the Arts and Manufactures,

AND THE RECORDING OF

AMERICAN AND OTHER PATENT INVENTIONS.

EDITED BY

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JOURNAL
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THE FRANKLIN INSTITUTE
OF THE STATE OF PENNSYLVANIA
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PROMOTION OF THE MECHANIC ARTS.

JANUARY, 1856.

CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

Method of Calculating Excavation and Embankment. By GEORGE A.
SIMONSON, Polytechnic College of Pa.

The shortest way of making these calculations is by the aid of diagrams invented by Mr. J. C. Trautwine, Civil Engineer. But as the engineer is sometimes required to estimate earth-work, when these diagrams are not in his possession, and as the shortest rule at present employed which will give accurate results, is the prismoidal formula, which is certainly very tedious, it is expedient that a shorter equation for the solidity be prepared.

After finding the end areas, according to the usual rule, *i. e.*, multiply the extreme horizontal width by half the centre cutting, and add the product to $\frac{1}{4}$ the width of the roadway into the sum of the outside cuttings; we can find an expression for the solidity in terms of these areas, the width of the roadway and the slope of the bank. The following equation, original with me, I believe to be as simple as any. Denote the greater area by A , and the lesser by a ; Express the length of the embankment or excavation by L , the depth of the greater cut by c , and that of the lesser by c' . c , and c' , are the cuttings of level cross-sections having the same areas, respectively, A and a , as the sections under consideration. Denote the horizontal width, or the distance between the two slope stakes of a level excavation whose depth is equal to c , by w , and the horizontal width corresponding to c' by w' . Let r equal the width of roadway, and s the

horizontal distance for a unit of height in the slope, and, finally, let s stand for the solidity; then the expression deduced for s is

$$s = \frac{L}{3} \left(2a + A + \frac{A-a}{\sqrt{\frac{4As+R^2}{4as+R^2}} + 1} \right)$$

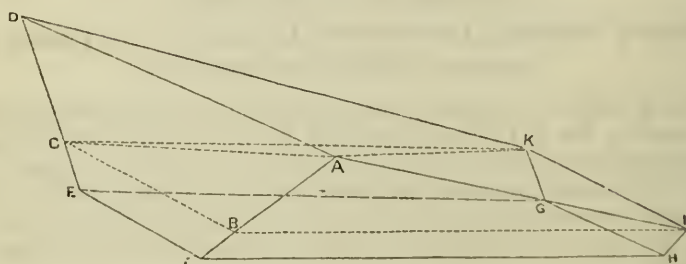
The expression by the prismoidal formula is

$$s = \frac{L}{6} \left(A + a + 4 \left(\frac{\frac{3}{2} \left(\sqrt{\frac{2A}{3} + \left(\frac{R}{3}\right)^2} - \frac{R}{3} + \sqrt{\frac{2a}{3} + \left(\frac{R}{3}\right)^2} - \frac{R}{3} \right)}{2} + R \right) \times \right. \\ \left. \left(\frac{\sqrt{\frac{2A}{3} + \left(\frac{R}{3}\right)^2} + \sqrt{\frac{2a}{3} + \left(\frac{R}{3}\right)^2} - \frac{2R}{3}}{2} \right) \right)$$

when the slope is $1\frac{1}{2}$ to 1, or that most generally used, and for any slope.

$$s = \frac{L}{6} \left(A + a + 4 \left(s \frac{\sqrt{\frac{A}{s} + \left(\frac{R}{2s}\right)^2} + \sqrt{\frac{a}{s} + \left(\frac{R}{2s}\right)^2} - \frac{R}{s}}{2} + R \right) \times \right. \\ \left. \left(\frac{\sqrt{\frac{A}{s} + \left(\frac{R}{2s}\right)^2} + \sqrt{\frac{a}{s} + \left(\frac{R}{2s}\right)^2} - \frac{R}{s}}{2} \right) \right)$$

It will be seen that the first equation is much shorter than the prismoidal formula. Let us now consider its demonstration.



Let $ADEF$ represent the cross-section of a level cutting c , equal A , and $GHIK$ that of a cutting c' equal a . The solidity in practice is considered equal to that of a regular prismoid whose end areas and length are equal to any irregular one under consideration. This, however, is not strictly true, because the surface of the ground excavated will usually be more or less warped. When very much warped, intermediate cross-sections between two stations, must be taken. Under the supposition that the irregular solid is equivalent to the regular prismoid in the figure, let us find its solidity.

Make $FB = HI$ and $CE = GK$, join B and C , B and I , and C and K . The solidity of the prism thus formed of which each of the end areas equals a , and the length of which is the length of the whole solid equals $a \times L$. Draw

AC and AK forming the rectangular pyramid whose vertex is at A, and whose base is B C K I = $w \times L$. Now the altitude of this pyramid is $c - c$, hence its solidity = $w \times L \times \frac{c - c}{3}$. There remains the triangular pyramid whose base is A C D and whose altitude is the length of the prismoid, because its vertex is at K. Its solidity = $\frac{w \times (c - c)}{2} \times \frac{L}{3}$. But the prismoid is made up of the prism and the two pyramids, hence we may write for its solidity,

$$s = aL + \frac{wL(c - c)}{3} + \frac{w \times (c - c)L}{6} \text{ or as } L \text{ is a common factor,}$$

$$s = L \left(a + \left(w + \frac{w}{2} \right) \left(\frac{c - c}{3} \right) \right) \text{ or by bringing } w \text{ and } w \text{ to a common denomi-}$$

$$\text{nator } s = L \left(a + \frac{2w + w}{2} \frac{c - c}{3} \right) = L \left(a + \frac{2cw + cw - 2cw - cw}{6} \right)$$

$$\text{But } A - a = A B C D = \frac{w + w}{2} (c - c) \text{ or } 2A - 2a = cw + cw - cw - cw;$$

now, by adding $cw - cw$ to each side of this equation, there results, $2A - 2a + cw - cw = 2cw + cw - 2cw - cw$; substituting this value in the last equation for the solidity, and bringing a into

$$\text{the numerator, we obtain } s = L \left(\frac{4a + 2A + cw - cw}{6} \right) \text{ but}$$

$$\frac{w + w}{2} (c - c) = A - a, \text{ or } c - c = \frac{2A - 2a}{w + w}. \text{ By multiplying both members of}$$

the last equation by w we get $cw - cw = \frac{w}{w + w} (2A - 2a)$; substituting this value in the last equation for the solidity, we obtain

$$s = \frac{L}{3} \left(2a + A + \frac{w}{w + w} (A - a) \right) \text{ or } s = \frac{L}{3} \left(2a + A + \frac{A - a}{\frac{w}{w} + 1} \right).$$

Let us now find a value for the widths in terms of the areas, slope, and roadway. We have first $\frac{w + R}{2} c = A$ because A D E F is a trape-

zoid. But $c = \frac{w - R}{2s}$; therefore $\frac{w^2 R^2}{4s} = A$, or $w = \sqrt{4As + R^2}$; in like man-

ner we should find $w = \sqrt{4As + R^2}$, and substituting these values in the last formula for the solidity, we obtain

$$s = \frac{L}{3} \left(2a + A + \frac{A - a}{\sqrt{\frac{4As + R^2}{4As + R^2}} + 1} \right) \text{ as previously given.}$$

This formula will apply to embankments, because an embankment presents the same figure as an inverted excavation.

Example. In the first cross-section, let the centre cut be 3 feet, the right cut 2 feet, and the left cut 5 feet. In the second, let the centre cut be 2 feet, the right cut 1 foot, and the left cut 4 feet. Required the solidity when the width of the roadway is 20 feet, the slopes $1\frac{1}{2}$ to 1, and the distance between the sections 100 feet.

$$\text{Here } A = (1\frac{1}{2} \times 5 + 1\frac{1}{2} \times 2 + 20) \times 1.5 + (5 + 2) \frac{20}{4} = 80.75,$$

$$a = (1\frac{1}{2} \times 4 + 1\frac{1}{2} \times 1 + 20) \times 1 + 5(4 + 1) = 52.5, \text{ and}$$

$$s = \frac{100}{3} (2 \times 52.5 + 80.75 + \frac{80.75 - 52.5}{\sqrt{\frac{4 \times 80.75 \times 1\frac{1}{2} + 20^2}{4 \times 52.5 \times 1\frac{1}{2} + 20^2}}} + 1)$$

$$s = \frac{100}{3} (185.75 + \frac{28.25}{\sqrt{1.237063}}) = \frac{100}{3} (185.75 + \frac{28.25}{2.1122}) = \frac{19912.5}{3} =$$

6637.5 cubic feet = 245.8 cubic yards.

By the prismoidal formula we find from the areas a cutting of an equivalent level cross-section by the formula $c = \sqrt{\frac{A}{s} + \left(\frac{R}{2s}\right)^2} - \frac{R}{2s}$ or

$$c = \sqrt{\frac{80.75}{1\frac{1}{2}} + \left(\frac{20}{3}\right)^2} - \frac{20}{3} = 3.24686 \text{ and } c = \sqrt{\frac{52.5}{1\frac{1}{2}} + \left(\frac{20}{3}\right)^2} - \frac{20}{3} = 2.24654, \text{ and } \frac{3 \cdot 24686 + 2 \cdot 24654}{2} = 2.7467, \text{ the middle cut. For the area}$$

corresponding to this cut we have $\left(\frac{2 \cdot 7467 \times 3}{2} + 20\right) 2.7467 = 66.2504,$

and by the prismoidal formula we have

$$s = \frac{100}{6} (4 \times 66.2504 + 80.75 + 52.5) = 6637.5 \text{ cu. feet} = 245.8 \text{ cu. yards.}$$

For the Journal of the Franklin Institute.

Panama Railroad.

We gather from a recent official report on this work, that its entire length is 47 miles and 3020 feet. The maximum grade is 60 feet to a mile, descending from the summit towards the Pacific; on the descent from the summit towards the Atlantic, the maximum is $58\frac{1}{6}$ feet to a mile. $23\frac{3}{8}$ miles are level and $28\frac{3}{8}$ miles are straight. It is a single track road, laid partly with a bridge or Ω rail of 58 pounds per yard; and partly with a Γ rail of 56 pounds. The gauge is not stated. Its cost, including rolling stock, land, depots, &c., will be about seven and a half millions of dollars, or about \$158,000 per mile.

AMERICAN PATENTS.

List of American Patents which issued from November 20th, to December 18th, 1855, (inclusive,) with Exemplifications.

NOVEMBER 20.

70. For *Improvements in Knitting Machines*; Timothy Bailey, Ballston Spa, N. Y.

Claim.—"1st, Actuating the sinking or other burrs, by means of a gear wheel, whose teeth are actuated, or rather acted upon, by the needles as a rack, whereby the wings in said burrs are freed from contact with the needles, and do not nip the yarn tightly between said wings and the needles, substantially in the manner and for the purpose described. 2d, Carrying back the old stitch and holding it back, by means of a disk wheel and segment, having a planetary motion, as herein set forth; and also the leading of the finished cloth, through a ring or its equivalent, surrounding a shaft having a planetary motion, whereby the action of the drag weights is properly adjusted upon different portions of that circuit of the cloth which is being acted upon by the needles and levers, substantially as herein specified, and in combination with a cloth or knitted tube, to which is imparted substantially such a revolving motion as is herein described. 3d, A self-adjusting climbing drag weight, constructed substantially in the manner herein set forth. 4th, A stationary series of needles in circuit, when constructed and arranged substantially in the manner described, in combination with revolving levers, driven by independent gearing, and traveling from needle to needle, whereby the turning of the finished cloth on its own axis is avoided, and all difficulties incident thereto obviated."

71. For an *Improvement in Mop Heads*; Alexander Burns, Ashtabula, Ohio.

Claim.—"What I claim as new and my invention, and for which I desire to secure letters patent, is attaching the screw to the cross piece and riveting it in such a manner that its revolution is not obstructed, combined with the bow and nut as described, for the purpose specified."

72. For an *Improvement in Cutting Teeth of Gear Wheels*; G. W. Bigelow, New Haven, Connecticut.

Claim.—"Giving the blank or wheel to be cut, an automatic feed motion, by means of the pulley on the shaft, said pulley having a coil spring within it, the screw on the shaft, the worm wheel on the lower ends of the shaft, and the circular plate, having projections upon its periphery, and the pawl and bar provided with the arm, the cam being operated by the pins on the inner side of the pulley; the above parts being arranged substantially as shown and described."

73. For an *Improvement in Locks*; J. H. A. Bleckmann, Ronsdorf, Prussia.

Claim.—"The mode of constructing and arranging one, or a number of tumblers as described, which may be locked and opened with changeable key bits."

74. For an *Improvement in Cotton Gins*; Lewis S. Chichester, City of New York.

Claim.—"Giving to one or both of the rollers of a roller gin, the separating motion, to separate the rollers for discharging the seed, after the fibres have been separated. Also, the guard and discharge plates, in combination with the two rollers of a roller gin, having a separating motion. Also, the clearing and collecting brush, in combination with the ginning rollers."

75. For an *Improvement in Double Acting Pumps*; D. W. Clark, Bridgeport, Conn.

Claim.—"Giving to the two reciprocating pistons when arranged, to move in the one cylinder, by intermediate gear, a simultaneous travel in the same direction, at about the period of change of stroke in the pistons, while for the remainder, or the greater part of their stroke, they travel in opposite directions, to effect the required double action specified, of the two pistons in the one cylinder, and whereby the one piston serves to follow up the movement of the other, in their joint action upon the one body of water between the pistons, till a fair hold is got upon the water to render the suction continuous, neutralize the effect of leakage, and prevent the formation of an air or vacuum space, between the two pistons, at their turning stroke, and run apart from the water between them, by means of the revolving eccentrics or their equivalents, pitched or set with "lead" in relation to each other, and the two pistons of the single cylinder."

76. For *Ticket Holders*; Edward Pierre Fraissinet and Henri Emile Reboul, Paris, France.

Claim.—"The construction of an apparatus or instrument for carrying, securing, and exhibiting tickets."

77. For an *Improved Machine for Printing Yarns and Cloths*; Thomas Henderson, Lowell, Massachusetts.

Claim.—"1st, The printing or coloring types. 2d, The coloring distributors, and boxes in which they revolve. 3d, The types, in combination with jacquard operation, for printing and coloring figured goods. 4th, The types, in combination with the color distributors and boxes."

78. For an *Improvement in Treating Leather for Enamelling*; Theodore P. Howel and Noah F. Blanchard, Newark, N. J.

Claim.—"The combination of the cylinder with the elastic slotted bags, for softening tanned and dry leather for japaning purposes."

79. For an *Improvement in Hand Seed Planters*; D. W. Hughes, New London, Mo.

Claim.—"The seed box and perforated slide, when attached to the blades connected by a joint."

80. For an *Improved Method of Attaching Tops to Seats of Carriages*; Lyman Jacobs and E. C. Landon, Castile, New York.

Claim.—"The method of concealing the back rails of seats to carriages, by means of grooves in the back of the tops. Also, in combination with the grooves, the mode of fastening tops to seats of carriages, by means of beveled nuts and bolts."

81. For an *Improvement in Potato Digger*; Aaron A. Marcellus, City of New York.

Claim.—"In combination with the revolving rakes, the undulating surfaced separator and receiver."

82. For *Policemen's Rattles*; Joseph McCord, Philadelphia, Pennsylvania.

Claim.—"The securing of the handle to the edge of the ratchet wheel, and at right angles to the axis of the latter, for the purpose of turning down the handle out of the way, thereby rendering the instrument more convenient to carry in the pocket, and for the further purpose of combining a mace and rattle in one instrument."

83. For an *Improvement in Railroad Station Indicators*; Charles A. McEvoy, Richmond, Va.

Claim.—"Presenting a movable sign or symbol, to passengers of a railroad car, so that both sides of said sign shall be visible and utilized as communicators, by swinging said signs to the angles of a polygonal reel, in such manner as to make each sign in turn drop through a slot."

84. For an *Improvement in Gun Locks*; John Phin, Rochester, New York.

Claim.—"Securing accuracy of aim and safety in the use of trigger-cocking fire arms by means which consist, first, in the sear and spring to hold the hammer up, and, secondly, in the spring acting on the trigger, to release said hammer."

85. For an *Improvement in Cotton Presses*; William F. and Charles J. Provost, Selma, Alabama.

Claim.—"1st, The manner of hanging and holding the platen, by means of the rod and the coupling link, so that the platen may be swung around out of the way and the rod let down. 2d, A combination with the levers and their fulcras, the pivoting of the long one of said levers, to one side of the centre of the follower to cant, and to apply the power of the press in as near a direct line to the resistance as possible."

86. For an *Improved Machine for Preparing Leather, for the Manufacture of Boots and Shoes*; Charles Rice, Boston, Mass., and Sylvanus H. Whorf, Roxbury, Massachusetts.

Claim.—"1st, The retracting guard, in combination with the spring and rod, when constructed, arranged, and operating from the raker's seat. 2d, The grain guard."

87. For an *Improved Marble Sawing Machine*; F. Noette and A. Schmidt, Brooklyn, New York.

Claim.—"The combination and arrangement of the described devices, when the same are all arranged and operated in the precise manner described, and not otherwise."

88. For an *Improved Street Sweeping Machine*; M. W. St. John and Isaac Brown, Leonardsville, New York.

Claim.—"1st. The reciprocating brooms or brushes, attached to a bar which is connected with the pitmans. 2d. The endless apron placed underneath the machine, for the purpose of receiving the dirt from the brooms or brushes, and carrying it from underneath the machine and depositing it in winrows in the street. 3d. The combination of the endless apron and reciprocating brooms or brushes. 4th, Connecting the swivel wheel with the back end of the draft pole by a lever. 5th, Placing the driving wheels and pinions loosely on their respective shafts, and operating the ratchets by means of the flanged sliding plate, for the purpose of throwing the working parts of the machine in and out of gear with the driving wheels."

89. For an *Improvement in Coal Sifters*; Gerard Sickels, Brooklyn, New York.

Claim.—"The peculiar manner of dividing the cylinder, for the purpose of furnishing a receptacle for the separated coal."

90. For an *Improved Method of Inserting Tubes in Evaporating Pans, &c.*; George H. Thomas, Kingston, Mass.

Claim.—"The method of securing tubes to tube sheets, by making the tubes without projections on the surface, that they may be inserted directly through holes in the tube sheets, in combination with clamps at the ends of the tubes and overlapping the joints."

91. For an *Improvement in Revolving Measuring Wheels*; Louis Young, City of New York.

Claim.—"The arrangement of the box containing the count wheel, in connexion with the stock carrying the measuring wheel, in such manner that said box is made to serve as a convenient handle for working the instrument."

92. For an *Improvement in Nutmeg Graters*; Hiram Carsley, Assignor to self and Edmund Brown, Lynn, Mass.

Claim.—"The combination of the box and holder, and the pressure spring, or contrivance with the rasping surface of the grater."

93. For an *Improvement in Lifting Jacks*; Francis Drew, Assignor to self and Solomon S. Gray, South Boston, Mass.

Claim.—"The jack, consisting of the sockets, with their connecting arms and pawls, in combination with the ratchet wheels and cog wheels."

94. For an *Improved Filtering Faucet*; Louis Finger, Assignor to self and Lazarus Schell, Boston, Mass.

Claim.—"The brush, in combination with the plate and passages."

95. For an *Improvement in Mills for Grinding Coffee, &c.*; Cornelius W. Van Vliet, Fishkill Landing, New York, Assignor to Charles Parker, Meriden, Conn.

Claim.—"The peculiar arrangement of the crushing and grinding cones, and in combination therewith, the passage leading from the largest circumference of the upper cone to the smallest circumference of the lower cone."

96. For *Improved Envelopes*; Emanuel Harmon, Washington, D. C.

Claim.—"The manufacture or preparation of envelopes with parallel lines on the interior of the back."

97. For an *Improvement in Mills for Grinding Apples*; W. O. Hickok, Harrisburg, Pennsylvania.

Claim.—"The breakers, whether used in combination with the helical ribs and the tube, so as to produce a separate and distinct depression around each tooth, or whether the said breakers are used in combination with the teeth above."

NOVEMBER 27.

98. For a *Balance for Detecting Spurious Coin*; John Allender, New London, Conn.

Claim.—"A single lever of such a size and weight, and provided with cavities or counter sinks, arranged at such distances each side of the fulcrum, as to weigh the smaller coins upon the lightest arm without additional weight, and the larger coins, two or more, on the heaviest arm with one weight in one position on the lighter arm."

99. For an *Improvement in Blacksmiths' Striker*; Dennis S. Blue, Fort Seneca, O.

Claim.—"The use of slotted lever treadle, the slotted lever, and the rock shaft."

100. For an *Improvement in Steam Heating Apparatus*; Pliny E. Chase, Philadelphia, Pennsylvania.

Claim.—"The peculiar arrangement of the pipes, the draft pipes, and the tanks, in combination with the steam chamber."

101. For an *Improvement in Belt Coupling*; Thomas H. Corbett, Brooklyn, N. Y.

Claim.—"Coupling the two ends of a belt or any two objects together by means of two clamps and a double wedge key."

102. For an *Improvement in Fences*; H. H. Dennis, Steam Mill, Pennsylvania.

Claim.—"The mode of connecting the rail and post by mortise with convex top and bottom groove."

103. For an *Improvement in Drilling and Screw Cutting Machines*; Joel P. Heacock, Marlborough, Ohio.

Claim.—"The use of pulleys and set ring, operating conjointly on the feather."

104. For an *Improvement in Coopers' Tool*; Joel P. Heacock, Marlborough, Ohio.

Claim.—"The constructing of a "cooper's tool" for the purpose of over-shaving."

105. For an *Improvement in Cat-Head Anchor Stoppers*; Peter H. Jackson, City of New York.

Claim.—"The combination of the locking piece with its cam, combined with the hasp, so that said cam piece forces the hasp out of the notch, as said locking piece is turned to one side, and causes the ring or loop over the hasp to be thrown off or disconnected."

106. For an *Improvement in Bag Looms*; L. B. Jillson and George Sparhawk, Lewiston, Maine.

Claim.—"1st, Placing the two sets of studs of the pattern cylinder for weaving the sides and bottom of the bag in slides fitted to the cylinder, to slide longitudinally thereto, so as to admit of the changing of the harness motion from weaving the sides to weave the bottom of the bag, or vice versa, by shifting the whole or any number of the said slides, according to the number of picks desired in the bottom. 2d, The combination of the sliding rod, having a fork and finger, with the notched disk carrying the pinion, the pawl, or its equivalent, the worm wheel, and the endless screw on the cylinder, all operating for the purpose of shifting the slides in the cylinder to change the operation of the harness."

107. For an *Improvement in the Method of Hanging the Screens of Winnowing Machines*; John A. Krake, Alden, New York.

Claim.—"The peculiar arrangement and combination of parts, by which the action of the screens is confined, exclusively, to lateral vibratory motion."

108. For an *Improvement in the Preparation of Umbrella Sticks, &c., of Ratan*; Joseph Kleeman, Meissen, Germany.

Claim.—"The preparation of ratan by impregnating it with drying oils and varnishes, for the purpose of giving it flexibility, elasticity, tension, and an appearance similar to whalebone, the ratan so prepared to be used as a substitute for whalebone in the manufacture of umbrella and parasol frames, and for other purposes for which whalebone can be employed."

109. For an *Improvement in Cannon*; Alfred Krupp, Essen, Prussia; patented in France, December 16, 1847.

Claim.—"1st, The manufacture of cannons from solid pieces of cast steel. 2d. The surrounding cannons and other parts of artillery when made of cast steel with an outer casing of cast iron, steel, or wrought iron, or gun metal."

110. For an *Improvement in the Mode of Cutting the "Uppers" of Boots*; John S. Lewis, Athol, Massachusetts.

Claim.—"Cutting the boot front all the way down no wider, or but little wider, than the usual width of the part which is to form the front of the leg and filling the vacancy which is thus caused, when the joint is crimped by a separate piece, by extending the back or counter, or by a piece produced in any other way, whereby the saving is effected in cutting the fronts."

111. For an *Improvement in Attaching Casters to Trunks*; Leonard S. Maring, Fall River, Massachusetts.

Claim.—"Constructing and arranging casters on trunks."

112. For an *Improvement in Machines for Rasping and Dressing the Heels and Soles of Boots and Shoes*; Jean Pierre Molliere, Lyons, France; patented in France, January 5, 1855.

Claim.—"The circular tools, with rasping and dressing the bottoms of heels and soles of boots and shoes."

113. For an *Improvement in Ovens for Baking Bread and other Aliments*; Jean Louis Rolland, Paris, France; patented in France, June 30, 1851.

Claim.—"The arrangement of the horizontal flues within the hot air chamber and beneath the baking floor."

114. For an *Improvement in Sewing Machines*; George W. Stedman, Vienna, N. J.

Claim.—"Feeding the cloth, or other material, along by means of the thread which is suitably acted upon, for the purpose of tightening each stitch."

115. For an *Improved Printing Press*; Cyrus A. Swett, Boston, Massachusetts.

Claim.—"Inking the blocks with their appropriate colored inks by means of the rollers. Further, the cylinder vibrating bed or plate with endless apron attached."

116. For an *Improvement in Metallie Saddle Trees for Harness*; Samuel E. Thompson, City of New York.

Claim.—"Providing metallic harness saddle trees with an elevated bridge. And, in combination with the same, employing ribs on the front portion of the underseat."

117. For an *Improvement in Feet Warmers*; Nathaniel Waterman, Boston, Mass.

Claim.—"Placing the hot water vessel within a case made of wood, except on that side on which the feet are to rest, which side is made of thin sheet metal, and cushioned and covered, the whole being for the purpose of retaining the heat longer and giving it out more regularly to the feet."

118. For an *Improvement in Fluid Lamps*; William Bennett, Brooklyn, N. Y., Assignor to the Union India Rubber Lamp Company, City of New York.

Claim.—"The elastic bag or receptacle placed within the body of a lamp, or within a proper framing or support to receive and hold the fluid."

ADDITIONAL IMPROVEMENT.

1. For an *Improvement in Ventilating and Warming Houses*; Henry Ruttan, Coburg, Canada; original patent dated Dec. 5th, 1848; additional, Nov. 6, 1855.

Claim.—"The foul air receptacle, added to and connected with the system of ventilation, patented to me Dec. 5th, 1848, said receptacle being connected with the vertical passages and ventilating chimneys."

RE-ISSUE.

1. For an *Improvement in Harvesting Machines*; Jonathan Haines, Pekin, Illinois; patented March 27th, 1849; re-issued November 6, 1855.

Claim.—"In combination with a frame nearly balanced on its supporting wheels, and a tongue hinged to said frame, a lever connected to one, and projecting towards the driver's stand or seat on the other, so that the driver, who is the sole conductor of the machine, may, from said stand or seat, raise or depress the cutters, at pleasure, during the operation of the machine for cutting the grain or grass, at any suitable height above the ground, or for passing over any intervening obstacles, substantially as described. Also, in combination with the operative parts of a harvesting machine, a conveyor, which first carries the cut grain horizontally across the machine, and then elevates it so as to discharge the grain into the bed of a wagon driven alongside of the machine, when the conveyor frame is connected to the bed, by a flexible joint."

DESIGNS.

1. For *Coal Stoves*; Garrettson Smith and Henry Brown, Assignors to Leibrandt, McDowell & Co., Philadelphia, Pennsylvania; dated November 6, 1855.

Claim.—"The combination of ornaments, the whole forming an original design for a coal stove."

2. For *Stoves*; Benjamin Wardwell, Fall River, Massachusetts; dated Nov. 20, 1855.

Claim.—"The border on the edge of the base, the borders and other embellishments on the doors, the wreath on the rim or projection of the cylindrical portion of the stove, and the embellishments on the panels on the cylindrical portion."

3. For *Steam Tubes and Hot Air Covers*; James O. Morse, City of New York, and J. W. Adams, Lexington, Kentucky; dated November 27, 1855.

Claim.—"The scrolls and the figured ground work on the trusses, and the circular embellishment and figured fret work on the panel; also, the fret work in the frame or borders."

DECEMBER 4.

1. For an *Improvement in Suspending Ships' Yards*; Thomas Batty, Brooklyn, N. Y.

Claim.—"The arrangement of the yard, the beam, and the crane."

2. For an *Improvement in Cutting Pile Fabrics*; Erastus B. Bigelow, Boston, Mass.

Claim.—"The employment of a rotating cutter, in combination with take-up rollers."

3. For an *Improved Mode of Hanging Window Sashes*; E. W. Bullard, Hardwick, Massachusetts.

Claim.—"The improved mode of hanging and fastening sashes, which consists in beveling one side of the sash and combining therewith a corresponding wedge or beveled strip moved up and down, by which arrangement the modes of fastening, loosening, and removing the sashes from the frame are secured."

4. For an *Improvement in Military Saddles*; Daniel Campbell, Washington, D. C.

Claim.—"1st, Placing the arch of the connecting strap of the holsters below the pommel of the saddle, and supporting the holsters upon projections from the forward ends of the side bars of the saddle tree, or their equivalent. 2d, Covering the holsters, by means of the roof piece attached to the connecting strap of the holsters, and the covers which are pivoted to the sides of the holsters. Also, constructing the valise of two connected receptacles which are supported immediately in the rear of the legs of the cantel."

5. For an *Improvement in Making Plough Mold Boards*; Thomas A. Chandler, Rockford, Illinois.

Claim.—"The forming eccentric roller, clamp plate, with the lever, and the press-plate."

6. For an *Improvement in Machines for Sawing Out Tapering Blocks of Marble*; John A. Cole, Washington, D. C.

Claim.—"Attaching the saw to swinging frame by pivots at each end, which will admit the shoes turning to any angle to follow guides."

7. For an *Improved Instrument for Chamfering the Edges of Shoe Soles, &c.*; Alonzo R. Dinsmoor and Levi J. Bartlett, Salisbury, New Hampshire.

Claim.—"The combination and arrangement of the lever gauge and spring presser, with the knife blade or chisel."

8. For an *Improvement in the Arrangement of Flues and Dampers in Cooking Apparatus*; John A. Elder, Westbrook, Maine, and Wm. J. Thorn, Holliston, Mass.

Claim.—"The arrangement of the dampers, in combination with the oven flues for regulating and controlling the heat."

9. For an *Improvement in Car Coupling*; Joseph T. England, Baltimore, Md.

Claim.—"The coupling consisting of a ball so arranged in the buffer-head, as to support, at its lowest position, the pin, and to be pushed away and allow the pin to fall on the introduction of the link."

10. For an *Improvement in Wool Combing Machines*; Peter Fairbairn, Leeds, and John Hargrave, Kirkstall, England; patented in England, November 6, 1852.

Claim.—"Combining in one and the same machine, two or more rotary gill cylinders fitted with advancing and receding gills, and rotating at different speeds."

11. For an *Improvement in Feet Warmers*; Henry Fourcreek, Elbridge, N. Y.

Claim.—"The arrangement of the angular supports upon the inner box, thereby providing the foot warmer with a hot air chamber; also, with substantial supports for the outer box."

12. For an *Improvement in Military Wagons*; Joseph Francis, City of New York.

Claim.—"1st, Constructing the bodies of road wagons and like vehicles of corrugated plate metal, supported by a bottom frame permanently attached thereto, so as to serve to support the iron body at all times, and be used as a sled upon which to drag the superstructure when taken off its wheels, and made water-tight for transportation. Also, the mode of attaching and detaching the running gear, so as not to pass any bolts which are liable to wear and cause a leak through any part of the water-tight body, but simply to connect the same with the frame by the outside connexions and braces, so as to securely brace the iron body in proper form and be permanently united therewith."

13. For an *Improvement in Bagasse Furnaces*; Samuel H. Gilman, New Orleans, La.

Claim.—"The pit located between the furnace and the boilers in a passage way. Also, the perforated blast pipes of the feed opening."

14. For an *Improved Burglars' Alarm*; Samuel Hamilton, Tolland, Massachusetts.

Claim.—"Constructing an alarm with an actuating pull knob, having a catch spring watch disk formed with a tube, together with the rail, the blocks, links, hook spring, sliding blocks, with catch devices, the secret spring strip; through all of which, in combination with clock work devices, are actuated bells or alarms."

15. For an *Improvement in the Machine for Cutting Out Boot and Shoe Soles*; Jesse W. Hatch, Rochester, New York.

Claim.—"1st, The projections at different distances on the face of the wheel and the fork on the sector lever, having its prongs at different elevations. 2d, The application of the spring friction bar to the yoke for preventing the return of the sector lever before the proper time."

16. For an *Improved Burglars' Alarm*; Horace L. Hervey, Quincy, Illinois.

Claim.—"The combination and arrangement of levers, springs, stop levers, slotted levers, key levers, flat sided levers, connecting levers, and links, varying the alarm at pleasure by means of the stop levers and for drawing the bolt."

17. For an *Improvement in Hand Cotton Pickers*; George A. Howe, Worcester, Mass.

Claim.—"The endless belt or chain of gatherers, stripper, bag, and case."

18. For *Improvements in Cutting the Fronts and Backs of Violins*; Matthias Keller, Philadelphia, Pennsylvania.

Claim.—"1st. The slides with the pattern, lever, and spindle with its cutter, for the purpose of forming any number of exactly similar backs and fronts of violins from one pattern. 2d, The supplementary lever with its connexions, in combination with the levers and slot, for the purpose of forming the concave sides of backs and fronts of violins, without changing the pattern used for forming the convex sides, and for the purpose of giving the said backs and fronts a gradual and correct tapering thickness."

19. For an *Improvement in Amalgamators*; Edward N. Kent, City of New York.

Claim.—"The employment of double action paddle wheels, which rotate on their own axis, and revolve about a vertical axis, within, and in combination with a column of water in a vessel having the discharge at or near the top. Also, sustaining the paddle wheels in the column of water from above, and causing them to rotate on their own axis by the weight of the heavy pan resting on the peripheries above, that mercury may be employed in combination therewith at the bottom and below the wheels."

20. For an *Improvement in Locks*; Edward Kershaw, Boston, Massachusetts.

Claim.—"In connexion with a rotating lock bolt, or its equivalent, the combination of the shank and segmental tumblers with the tubular recess of the lock case enclosing the same, with their several subordinate appendages co-operating with each other."

21. For an *Improvement in Pumps*; Hosea Lindsey, Asheville, North Carolina.

Claim.—"The horizontal cylinder and pipe connected, the cylinder being provided with valves and piston rods, being operated as the pipe and cylinder rotate by the curved flanch."

22. For an *Improvement in Spoke Machines*; Thomas R. Markillie, Winchester, Ill.

Claim.—"The arrangement of the cam on the pattern, in combination with the tracer and a spring. Also, the particular arrangement of the rotary cutter and tracer, in combination with the plate that supports them suspended."

23. For an *Improvement in Machines for Scouring Knives*; G. M. Morris and J. Newton, Watertown, Connecticut.

Claim.—"The machine for scouring knives, the same consisting of two scouring rollers and a trough for containing the cleansing material, said rollers being arranged over each other above the trough, and each of them formed of a series of woolen or other absorbent elastic disks, arranged on a screw shaft and forced and confined compactly together by two movable metallic disks."

24. For an *Improvement in Locks*; J. H. Pomeroy, Bloomington, Illinois.

Claim.—"The use of the spring bolt or catch, or its equivalent, so constructed as to be operated by the door frame or keeper to release the bolt and fasten the door."

25. For an *Improved Photographic Bath*; Isaac Rehn, Philadelphia, Pennsylvania.

Claim.—"The overflowing bath with the conducting trough and receiving chamber, or their equivalent."

26. For an *Improvement in Boot Trees*; James H. Sampson, Grafton, Massachusetts.

Claim.—"The combination and arrangement of the three levers and the screw applied to the two sections of the tree and made to operate together. Also, the combination of the spring lever catch with the foot and front section."

27. For a *Self-Regulating Hot Blast for Furnaces*; Charles Schinz, Camden, N. J.

Claim.—"The use of the pipe and the bar, operating conjointly by means of suitable gearing upon the eccentrics for opening and closing the valves, so as to divide a given volume of air of varying temperature and pressure into proportionate parts."

28. For an *Improvement in Cloth Stretching Rollers*; Nathan Simmons, Providence, Rhode Island.

Claim.—"The improvement in the cloth stretching roller or cylinder, consisting in imparting to its sectional stretchers while the roller is in revolution, consecutive movements in one direction or away from the middle of the roller."

29. For an *Improved Means of Connexion between Regulator Valve and Governor Stem*; John Tremper, Philadelphia, Pennsylvania.

Claim.—"Effecting the connexion between the throttle valve cut-off, or other regulator valve and the governor stem, by means of a pin working within a slot or against a bearing face, the said slot or bearing face having an escape opening, opposite to which, the pin is brought by the cessation of the operation of the governor, whereby the pin is allowed to escape from the said slot or bearing face, and thereby effect the disconnexion of the governor from the valve or cut-off, instantaneously, to allow the valve to be closed by a spring or weight, provided for the purpose, to stop the engine immediately after the governor ceases to operate, the said pin being attached to the governor rod, and the said slot or bearing face and escape opening being in or upon the lever of the throttle valve or cut-off, or what is equivalent, the pin being attached to the said lever and the slot or bearing face and escape openings being in the connecting rod of the governor or in a plate connected therewith, or what is equivalent, a toothed rack and segment."

30. For an *Improved Blind Fastener*; Daniel E. True, Lake Village, New Hampshire.

Claim.—"The arrangement of the spring bolt at the extremity of the outer lever, and connecting said lever with the blind, so as to be self-fastening, and withdrawn by the same lever movement operating the blind."

31. For an *Improvement in Machines for Paring and Slicing Apples*; Levi Van Hoesen, New Haven, Connecticut.

Claim.—"The combination of a spring with a slicing machine when constructed with an arrangement whereby the fork carrying the apple may be turned so as alternately to be brought into play with the paring knife and with the slicing wheel, being at the same time thrown into gear in the former case, and out of gear with the latter."

32. For an *Improvement in Quartz Crushing Machines*; Richard Vose, City of N. Y.

Claim.—"Supporting the centre of the inclined vessel upon a semi-spherical hub, which works in a raised perforated socket in the plate, whilst the depressed portion of the periphery of said vessel is supported upon a horizontal plane or track, by which I am enabled to impart the requisite movements to the said vessel through the medium of a shaft descending from a hub, and in connexion with the said method of supporting and operating the inclined vessel. Also, discharging the contents of the said vessel through an aperture in the descending operating shaft. Also, in connexion with the peculiar manner of supporting and operating the vessel, the combining of the periphery of said vessel with the supporting frame by means of the springs, or their equivalents, for the purpose of steadying the movements of said vessel and preventing it from turning upon its axis."

33. For an *Improvement in Hand Sowers*; Moses D. Wells, Morgantown, Virginia.

Claim.—"Effecting the seed discharge and regulating the amount of the same by means of the double inclined planes of bar reciprocating without the hopper."

34. For an *Improvement in Machines for Preparing Cotton Seed for Planting*; R. C. Wrenn, Covington, Kentucky.

Claim.—"Pads, in combination with cylinder and teeth, in combination with hopper slide."

35. For an *Improvement in Water Wheels*; John H. Gatiss, Franklindale, Pa., Assignor to Abraham Edwards, Towanda, Pennsylvania.

Claim.—"The arrangement of the gates, passages, and buckets of a centre vent wheel, so that the water may act upon each bucket simultaneously and with equal force, first striking them at their very lowest points, and held thereto by the lips or flanches, and then escaping to the centre discharge."

36. For an *Improved Machine for Channeling Stone*; John Taggart, Roxbury, Mass., Assignor to self and Vernon Brown, Boston, Massachusetts.

Claim.—"Supporting the operative machinery of the drill saws by means of standards extending down therefrom and resting upon the bottom of the grooves made with stone by said drills, the same enabling said operative parts or machinery to move downward with the drill in proportion as they may cut into the stone."

37. For a *Gimlet*; Chester C. Tolman, Assignor to James Sargent and Daniel P. Foster, Shelburne Falls, Massachusetts.

Claim.—"Constructing the lower or outer of the two screw threads or flanches of the gimlet in rounded or curved parabolic form, and having the sides of said portions of the threads or flanches brought to a sharp or cutting edge, the screw or worm being used or not, as desired."

38. For an *Improvement in Machinery for Opening and Feeding Cotton to the Gin*; Major B. Clarke, Newnan, Georgia.

Claim.—"The arrangement of the toothed feeding roller, the adjustable gate, and the adjustable comb with each other."

DECEMBER 11.

39. For an *Improved Application of Embossed Leather*; Israel Anies, Philadelphia, Pennsylvania.

Claim.—"The employment of embossed veneers in the construction of furniture, and for other ornamental purposes."

40. For an *Improvement in Machinery for Folding and Measuring Cloth*; James Baxendale, Providence, Rhode Island.

Claim.—"1st, The employment of separate rods for the several folds of the cloth, the said rods being arranged and operated to fall across the successive layers of the cloth, as they are laid, by the movements of a suitable reciprocating carriage over the folding table, and to remain within the folds till the folding of the whole piece is completed. 2d, The manner of operating the said rods to throw them from their upright positions across and upon the cloth by means of the nut and the screws, which are actuated by the movements of the reciprocating carriage."

41. For an *Improvement in Boot and Shoe Peg Cutters*; Henry E. Chapman, Albany, New York.

Claim.—"The making of shoemakers' floats or peg cutters with planing cutters."

42. For an *Improved Fountain Ink Stand*; Charles T. Close, City of New York.

Claim.—"The arrangement and combination of the upper tube or passage connecting the top or air space of the reservoir with the pen cup at or immediately below the level the ink is designed to stand in said cup, the latter being connected with the reservoir and the ink in the pen cup, forming a fluid valve that, upon the insertion of the pen and withdrawal thereof, alternately opens and closes the lower end of the upper connecting tube for the free, rapid, and certain admission of fresh air at intervals in the reservoir, as required."

43. For an *Improvement in Water Gauges for Steam Boilers*; Josephus Echols, Columbus, Georgia.

Claim.—"Making gauge tubes for indicating the height of water in steam boilers, with an aperture provided with convex glass, presenting the convex or arched surface to the pressure in the tube."

44. For an *Improvement in Gas Apparatus*; John S. Gallaher, Jr., and John W. Smith, Washington, D. C.

Claim.—"Solely, the arrangement of the parts, and specifically, of the retort, with Hooks's blow-pipe combined with the furnace, the water reservoir, the strainer, the receiver, for the purpose of constituting a compact and portable gas generating and purifying apparatus."

45. For an *Improvement in Railroad Car Springs*; P. G. Gardiner, City of New York.

Claim.—"My improved car spring is composed of a coiled plate spring, combined with a segmental brace and a movable segmental cap."

46. For an *Improvement in Tile Roofing*; Gottlieb Graessle, Hamilton, Ohio.

Claim.—"The construction of tile roofing, having each overlapping edge resting by an angle only upon the flat sublying surface between the ridges of the adjacent tile, and having two transverse ridges on the top of each tile, enclosed by similar ridges projecting from the superjacent surfaces of the tier next above."

47. For an *Improvement in Buckles*; Sheldon S. Hartshorn, Orange, Connecticut.

Claim.—"Constructing the tongue and loop of the buckle in one part and at one operation, in such a manner, that the socket will firmly secure the joint in the other part, so as to need no other fastening."

48. For an *Improvement in Machines for Raking and Loading Hay*; John K. Harris, Allensville, Indiana.

Claim.—"The pitcher or elevator, in combination with the rake, for the purpose of taking the hay from the rake in regular successive intervals of time and in separate parcels, and elevating and delivering it on the wagon."

49. For an *Improvement in Bedsteads*; Benjamin Hinkley, Troy, New York.

Claim.—"The cross bars, whether springs or not, for the support of a bedstead frame, when the same are mounted on a pedestal and stand."

50. For an *Improvement in the Mode of Attaching Extinguishers to Lamps*; F. A. Jewett, Abington, Massachusetts.

Claim.—"Attaching the cap or extinguisher to the lamp by means of a spiral spring coiled around the wick tube, and secured at one end to the cap and at the other to the screw plate or any other convenient locality, whereby the cup is tightly drawn down over the wick."

51. For an *Improvement in Locks for Freight Cars*; Henry C. Jones, Newark, N. J.

Claim.—"Combining with the double jaw spring bolts of a lock and with the levers by which the jaws are opened by the action of the key, a stop tumbler, operated by the key after the jaw bolts have been opened, to hold and keep them apart after the key is taken out of the lock, that the lock may be employed as a stop or dead bolt lock."

52. For an *Improvement in Corn Shellers*; James J. Johnson, Alleghany City, Pa.

Claim.—"The secondary cleaners or pickers, revolved around the cob as the cob is projected by the main cylinder through the opening in the case of the machine."

53. For an *Improvement in Sand Paper Making Machines*; Gilbert D. Jones, Jersey City, New Jersey.

Claim.—"1st, Applying the sand or grit in a heated state to the glued surface of the paper. 2d, The method of depositing the sand upon the glued surface, that is to say, by projecting it forcibly against said surface while in such reversed position, that the excess shall fall off by gravity. 3d, The combination of the stationary pieces, or their equivalent, with the moving drum, the paper, and the glueing cutter."

54. For an *Improvement in Machines for Cutting Out, Punching, and Stamping the Soles and Heels of Boots and Shoes*; Jean Pierre Molliere, Lyons, France; patented in France, July 22, 1853.

Claim.—"The cutting out of soles and heels by the blades from strips of hammered or other leather, sliding between the guide pieces and held in place by the stoppers, the pricking and stamping of the heels and soles, so cut out by the awls and the stamp at the same time, the three operations being performed at one stroke, the detaching from the blades and awls of the pieces cut out, pricked, and stamped by the detaching rods, and the adjustment of the eccentrics upon the shaft, in such manner, that two of the punches can operate in one and the same time."

55. For an *Improvement in Processes for Calico Printing*; Robert Prince, Lowell, Mass., and Ambrose Lovis, Boston, Massachusetts.

Claim.—"The manufacture of silicate of soda or potash containing foreign neutral salts, and the use of this compound with carbonate of soda and neutral salts in dunging operations."

56. For an *Improvement in Machines for Sawing Marble, &c., in Taper Form*; George T. Parsall, Apalachin, New York.

Claim.—"The employment or use of the levers being connected to the sockets of the bars and the uprights of the framing, and the levers being attached to the frame and the framing."

57. For an *Improvement in Packing Pistons for Steam Engines*; Joel W. Pettis, Hillsdale, Michigan.

Claim.—"The arrangement and application of the arms between the packing rings

and a movable centre bearing, whether the said centre bearing be movable to adjust or tighten the packing by means of a central rod passing through a hollow rod, or by other means."

58. For an *Impact Water Wheel*; Atchison Queal, Plymouth, New York.

Claim.—"The sliding buckets placed on the head of the wheel and operated by the inclined semi-circular rod, in combination with the partition. Further, attaching the wheel to the shaft by means of the pins fitting in the hub, the pins being attached to a ball on the shaft."

59. For an *Improvement in Carriage Hubs*; Shepherd W. Reed, Berkshire, N. Y.

Claim.—"The arrangement of the dodged mortises formed on both sides of the permanent projecting flanch or brace by the two angularly shaped projections radiating from the tube for the reception of the spoke tenon, whereby a double row of spokes may be inserted in the hub and supported by the flanch, in combination with the nuts to tighten or lock the spokes, and by which a broken or worn-out spoke may be removed and a new one inserted in its place without untiring the wheel."

60. For an *Improvement in Machines for Cutting Articles from Leather*; Charles Rice, Boston, Mass., and Sylvanus H. Whorf, Roxbury, Massachusetts.

Claim.—"Combining the cutting die with the platen by means of a rotary and adjustable plate, in combination with so applying the pack clamp to its pitman that it may turn thereon when the die or cutter is revolved. Also, the arrangement of the operative mechanism of the pack clamp and that by which the cutter is depressed or elevated."

61. For an *Improved Machine for Carving Wood, &c.*; Isaac M. Singer, City of N. Y.

Claim.—"Combining the tracer with the table which carries the block of wood to be carved by means of two systems of pentagraph levers operating at right angles with each other, whereby the block to be carved will be directed and presented to the action of the cutters in such manner, as to determine the configuration as well in a vertical as in a horizontal direction."

62. For an *Improvement in Corn Shellers*; Jeremiah P. Smith, Hummelstown, Pa.

Claim.—"The combination of the frustrums with their winding wings upon both, and cross projections upon one."

63. For an *Improvement in Slide Valves for Steam Engines*; E. D. Leavitt, Jr., Lowell, Massachusetts.

Claim.—"Making the valve and the corresponding parts of the steam chest between which it works, of tapering form laterally, and fitting the valve to its rod in such a manner, as to be capable of lateral movement, whereby the valve is always kept tight between the seat and the back of the steam chest by the pressure of the steam, and the wearing of the rubbing surface is always compensated for."

64. For an *Improved Piano Forte Action*; Francis Taylor, City of New York.

Claim.—"The regulating button permanently connected to, moving with, and governing the fly of the jack in its action on the but of the hammer."

65. For an *Improvement in Auger Handles*; Guillaume Henri Talbot, Boston, Massachusetts; patented in England, August 25, 1855.

Claim.—"The arrangement within the body of the said handle which crosses the bit of the ratchets and pawls with their running gear, for the operation of the bit or bit socket in either direction, either by a revolving or vibratory action of the gimlet handle on pressure of the hand when applied on both sides of the axial line of the bit, and under the usual clutch of the hand on the handle over the centre line of the bit, and whereby the actuating pawls, ratchets, and accompanying devices form no obstruction, and are protected from injury or derangement."

66. For an *Improvement in Cutting Cloaks*; Amasa S. Thompson, Albion, Pa.

Claim.—"Cutting a cloak from a seamless cloth without sleeves, so that by making four cuts of the proper length for the sleeves, the cloak may be worn as a sleeved sack or overcoat by merely changing the buttonings."

67. For an *Improved Manufacture of Cannon*; Daniel Treadwell, London, England.

Claim.—"Constructing cannon with hoops around and shrunk upon a body in which the calibre is formed."

68. For an *Improvement in Devices for Bleaching Ivory*; Wm. M. Welling, Brooklyn, New York.

Claim.—"The method of bleaching ivory plates by so placing and sustaining them on their edges in a suitable case, that the sun's rays shall act with uniform power and bleach said plates equally on both sides, thereby dispensing with the usual method of turning the plates over to expose alternately the flat sides to the action of the light and preventing warping or damage to the ivory, and accomplishing the operation in far less time and more perfectly."

69. For an *Improvement in Chain Making Machines*; Edward Weissenborn, City of New York.

Claim.—"1st, The employment for welding the rings of two rollers grooved spirally in opposite directions. 2d, Arranging one of the end bearings of one of the spirally grooved welding rollers, so as to be capable of sliding lengthwise to the roller, far enough to allow the ring to be slipped over the end of the roller. 3d, The manner of raising, depressing, and confining the upper roller to allow the ring to be slipped over the lower roller, to wit, by means of the rods, the yoke, the spring, and the cam shaft with the cam. 4th, The traveling box, operating to carry the rings quickly over the end of and up to the back end of the welding roller and to come back with the ring at a speed properly corresponding with the velocity of the rollers and pitch of their spiral grooves. 5th, The carrier operating, first, to move forward to receive the ring in its fork, then moving quickly upwards to snatch the ring from the box, and afterwards dragging the ring along the plate, which contains the elongating mechanism, till it comes in contact with one of the elongating parts, or its equivalent, as is thereby, and taken from the fork of the carrier. 6th, The combination of the movable parts and side dies operating to elongate the ring, and at the same time, close or drive towards each other the elongating sides. 7th, The arrangement of the dies round which the link is bent or doubled relatively to the dies, by which the elongated sides of the link are forced towards each other and their attachment to the same, whereby, when the link has received form, it is caused to be in readiness to be bent or doubled by the action of the hooks, or their equivalent. 8th, Operating the parts by which the elongation of the ring is performed by means of a wedge or double inclined piece attached to one of the side dies acting upon studs attached to the slides which carry the said posts, whereby the approach of the side dies towards each other and retreat of the posts from each other are effected simultaneously. 9th, The suspension of the bending hooks at their pivot, and application of a spring to draw the points apart, so that the said hooks will descend in an open state, and will be in condition to receive the link when the latter is sufficiently elongated, but that in ascending and drawing up the ends of the link, they will gradually close, as required by the changing form of the link."

70. For an *Improvement in Rotary Pumps*; C. D. Wright, Fort Atkinson, Wis.

Claim.—"The construction of the pump as shown, viz., the hollow spring placed within an inclined or oblique shell which forms the body of the pump, the sphere being attached to a hollow shaft at one side and communicating with a suction pipe at its opposite side, two opposite sides of the sphere fitting in concaves in the side of the shell, the sphere being also divided into two compartments, one of which communicates with the suction pipe and the other with the force pipe or hollow shell, the sphere having a flanch attached to it, which divides the shell or body into two compartments, and the flanch having a piston working in it, at each side of which apertures are made in the sphere."

71. For an *Improvement in Mosquito Curtains*; John S. Martin, Boston, Mass.

Claim.—"The new or improved manufacture of mosquito curtains as made of two bars, a sheet of cloth or netting, and a series of elastic bands."

72. For a *Method of Adjusting Circular Saws Obliquely to their Shafts*; Amos D. Highfield, Assignor to self and Wm. H. Harrison, Philadelphia, Pennsylvania.

Claim.—"The employment of two beveled washers between a fixed collar on the spindle and the circular saw."

73. For an *Improvement in Harvester Rakers*; John W. Haggard and George Bull, Assignors to Bull, Haggard, and Newsteter, Bloomington, Illinois.

Claim.—"The plate having its inclined and parallel planes on the same sides, in combination with the pin, bar, spring, and pin."

74. For an *Improvement in Variable Cut-Off Gear for Steam Engines*; William W. Wade, Assignor to Wade and Busham, Springfield, Massachusetts.

Claim.—"The arrangement of the induction and cut-off cams upon two parallel shafts, to operate in a yoke frame containing two separate yokes, one before the other."

75. For an *Improved Machine for Rubbing Types*; Daniel Moore, Brooklyn, N. Y., Assignor to George S. Cameron, Charleston, S. C., James H. McWilliams, City of New York, and Daniel Moore, Brooklyn, New York.

Claim.—"1st, Constructing the slice with openings to receive the type at such an angle, relatively with the directions which said slices move, that the cutters shall commence to act at the latter end of the type covered by said slices, and that the cutting operation shall tend to force the type into the bottom of said angle, and thereby retain the type in place in said slice. 2d, Constructing the slice in such a manner, that the power to force the type in an endways direction, or nearly so, through the cutters, shall be applied to or near the middle of the bottom end of the type. 3d, The follower of slides, and holding plate to supply the machine with a line of type. 4th, The lifter, combined with the gauge fingers and end of the plate or other stop, for the purpose of elevating one type at a time to be taken by the slices."

DECEMBER 18.

76. For an *Improvement in Looms for Weaving Pile Fabrics*; Erastus B. Bigelow, Boston, Massachusetts.

Claim.—"The employment of a latch or hook for successively drawing the pile wire from the cloth. Also, in combination with said latch or hook for drawing out the pile wires, the apparatus which receives the outer or head end of the pile wires from said latch or hook and transfers them to the face of the cloth."

77. For an *Improvement in Grain Cleaning Machines*; Jonathan L. Booth, Cuyahoga Falls, Ohio.

Claim.—"1st, In combination with the fan box enclosing the fan and provided with the hollow shaft through which the grain is fed, the cylinder, shell, and conical basin. 2d, The inverted conical basin with tube or pipe, provided with apertures attached, in combination with the shell, cylinder, and fan box. 3d, Feeding the grain into the space between the shell and cylinder by means of the hollow shaft and arms, whereby the grain is evenly fed into said space without interrupting or obstructing the current or blast which passes up through the cylinder, and the machine, also, rendered compact and efficient."

78. For an *Improved Saw Set*; T. C. Bush, New London, Connecticut.

Claim.—"The additional guard or stop, so constructed and arranged, as to enable the operator to set the teeth of a saw, alternately, in each direction without reversing the instrument or the saw."

79. For an *Improved Nozzle for Exhaust Pipes of Locomotives*; William E. Cooper, Dunkirk, New York.

Claim.—"The blast nozzle which forms the escaping steam into a circle, or its equivalent, and permits the products of combustion to pass up both sides of the annular steam track or current."

80. For an *Improvement in Paddle Wheels*; Frederic W. Capon, Newton, Mass.

Claim.—"The combination of one or more alleviators or skeleton paddles with each or any main paddle or float of a paddle wheel or propeller."

81. For an *Improvement in Fire Arms*; Joseph C. Day, Hackettstown, New Jersey.

Claim.—"1st, Connecting the two side pieces between which the barrel is hung by a hinge, and locking them by the projection and a corresponding recess. 2d, Making the face of the sliding collar of the shape of an arc with a cutting edge, so as to act in combination with the rear end of the cartridge. 3d, The grooves in the breech and the rear end of the barrel."

82. For an *Improvement in Piano Fortes*; Spencer B. Driggs, Detroit, Michigan; patented in England, November 1, 1855.

Claim.—"1st, Securing the sounding board within a metallic frame, or its equivalent."

lent. 2d, Combining the sounding board and its inclosing frame with upward projections, from an open metallic base frame, and with a wrest plank and an upper metallic frame or hitch plate, by which I am enabled to make a piano forte without using wooden blocks or other wooden supports for the wrest plank, sounding board, and upper metallic frame. 3d, In connexion with the combination of the upward projections from the open metallic base frame with the metallic sounding board frame, the wrest plank and the upper metallic frame, I claim combining a thin bottom board with a shallow wooden frame, which incloses the said open metallic base frame. 4th, In connexion with the inclosure of the thin sounding board within a metallic frame, and the combination of said frame with the upper metallic frame, the wrest plank and the open metallic base frame, I claim the combination of the said inclosed sounding board with the thin bottom board of the instrument by means of a sounding post, for the purpose of adding additional stiffness and vibratory power to both of said boards. 5th, Supporting the strings upon metallic saddles, which stride the sounding board bridge and are combined with said bridge and with the sounding board."

83. For an *Adjustable Crank Piece for Augers*; John Gourlay, Ogdensburg, N. Y.

Claim.—"The particular method of varying the length of leverage in handles."

84. For an *Improved Automatic Feed Motion for Saw Mills*; Henry C. Green, Clarence, Wisconsin.

Claim.—"The combination of the cones, governor, and pulleys."

85. For an *Improvement in Spike Machines*; A. M. George, City of New York.

Claim.—"The friction roller and lever, to which the cutter is attached when said roller and lever are placed upon adjustable centres, or pivots, or rods."

86. For a *Machine for Measuring Music*; H. B. Horton, Akron, Ohio.

Claim.—"Attaching the markers by which the notes are registered to light springs or flexible bars, which are so supported by the keys, when the latter are raised or not in operation, as to hold the points out of contact with the roll or other traveling sheet upon which the notes are registered until their respective keys are depressed, when losing that support, the points fall or are gently pressed upon the surface of the sheet. 2d, The method of operating the "bar marker" by which the bars are registered, by making it sufficiently elastic to hold the point off the sheet while it is left free, and striking it down in contact with the sheet, at intervals of time, bearing a proper relation to the movement of the sheet, by means of a hammer, and operated by a cam on one of the rollers which supports and moves or is moved by the sheet. 3d, The revolving vibrating indicator, arranged so as to be visible by the player, and the cam on the axle of one of the rollers, which drives or is driven by the sheet for the purpose of marking the time to lead or guide the player. 4th, Attaching all the note markers, and the bar marker, and the upper guide of the rods, through which the keys support the note markers to a frame, so that the whole can be moved simultaneously in a lateral direction to mark in different lines."

87. For a *Machine for Planing Felloes*; Wm. W. Johnson, Clifford, Pa.

Claim.—"The combination of the lever sliding in the arms, with the graduated lever and hollow cylinder or barrel being hinged, or any device substantially the same."

88. For an *Improvement in Moulds for Casting Bells*; Eber Jones, Troy, N. Y.

Claim.—"The so making of flasks for casting bells, the bodies of which are made of metal, so that the guides by which they are put together, shall be turned or moulded from the same centres from which the flasks themselves are coated with the lining or covering of clay or loam, and forming said guiding surfaces, where they are constantly under the ready inspection of the moulder."

89. For an *Improvement in Machines for Stuffing Horse Collars*; S. B. McCorkle, Greenville, Tennessee.

Claim.—"The cylinder provided with teeth or rods, and operated by the roller, lever, arm, and ratchet, for the purpose of feeding the straw to the plunger."

90. For an *Improvement in Machines for Polishing and Burnishing the Edges of Soles and Heels of Boots and Shoes*; Jean Pierre Molliere, Lyons, France; patented in France, January 5, 1855.

Claim.—"The rotary hollow tools, capable of being heated to any degree by the ad-

mission of steam, or other heating medium, into the chambers through the hollow shafts on which they turn from the regulating valve cocks, for the purpose of polishing and burnishing the edges of soles and heels of boots and shoes."

91. For an *Improvement in Machines for Mounting the "Uppers" of Boots and Shoes on Lasts*; Jean Pierre Molliere, Lyons, France; patented in France, August 19, 1854.

Claim.—"The arrangement of the adjustable frame and thumb screw armed with the toothed clamp, which, pressing vertically upon the inner portion only of the heel, holds the last securely in its position, and gives free access to the parts thereof on which any work is to be done by the apparatus."

92. For an *Improvement in Stone Dressing Machines*; Oldin Nichols, Lowell, Mass. and Ammi M. George, Nashua, New Hampshire.

Claim.—"The combination of the movable and adjustable eccentrics with the toggle joints for operating or driving stone dressing tools."

93. For an *Improvement in Instruments for Modifying Focal Length of the Eye*; Daniel Parish, City of New York.

Claim.—"The improved optical instrument herein described, for the purpose of improving and restoring the sight by giving greater convexity to the eye when flattened, and also, by depressing that organ when too convex."

94. For an *Improvement in Mill Spindle Steps*; Isaac N. Parker, Lewiston, Maine.

Claim.—"The formation in the step of the oil reservoir surrounding but separated from the spindle, and communicating with it by the opening at its bottom with the periphery of the spindle."

95. For an *Improvement in Horse Powers*; Samuel Pelton, New Windsor, Md.

Claim.—"The improvement, consisting in centering the wheels and pinions upon their several axles and bearings by beveling or dishing the wheels and extending their bearings, whereby the pressure is equalized upon the journals above and below each pinion and wheel, thereby preventing the unequal wear of the axles and journals, consequently, avoiding every tendency of the gearing to twist and break. Also, the mode of constructing and attaching the levers."

96. For an *Improvement in Automatic Gate for Railroad Crossings*; George B. Pullinger, Philadelphia, Pennsylvania.

Claim.—"The combination of the mechanism attached to the railroad track and operated upon by the locomotive or cars, for detaching from and bringing in contact the notched end of the lever with the end of the vibrating lever, with the upright spring levers, studs or projections on the ends of the flaps, and the means of operating the flaps and gates, or barrier bars, so as to enable the said gates or barrier bars to be depressed by the weight of the horse or other object when no danger is to be apprehended from the near approach of the locomotive or cars, but prevent the said gates or barrier bars being depressed to allow the passage on the track of any object, after the locomotive or cars having reached a point on the track sufficiently near the crossing to render the passage of such object unsafe, and not allow the said object to depress the gate or barrier bar through the agency of the inner flaps to get out from between the same, in case the locomotive or cars should have reached the point where it operates on the inclined bars, to prevent the depression of the outer flaps, and, consequently, of the gates or barrier bars, through this agency, until after the passage by the crossing of the said locomotive and cars."

97. For a *Plane for Finishing Grooves in Patterns, &c.*; John P. Robinson, Matteawan, New York.

Claim.—"Constructing the plane stock of triangular or three-sided prismatic form, the two lower sides forming a greater or less angle with each other and the plane iron fitted in the stock."

98. For a *Shingle Machine*; Joel Tiffany and Milo Harris, Painesville, Ohio.

Claim.—"Providing a primary and secondary set of knives, a primary and secondary set of feed rollers, and obliquely grooved driver, a primary feed carriage, and a pair of secondary feed grippers."

99. For an *Improvement in Organ Melodeons*; Thomas F. Thornton, Buffalo, N. Y.

Claim.—"Providing an additional set of valves and one or more additional sets of reeds, in a position the reverse of the usual arrangement of reeds, and extending the keys backwards in rear of the fulcrum, to actuate the additional set of valves through push-up pins, to play on the additional set or sets of reeds at the same time as they actuate the other sets of valves through the push-down pins to play the c, c, which are below them."

100. For *Improved Piano Fortes*; Hubert Schonaeker, Detroit, Michigan.

Claim.—"Constructing the instrument, so that the strings shall rest on a fret at the nodal or octave points, or substantially similar rest upon the bridge of the sounding board, whereby free vibration is allowed to the whole length between the hitch pins and bridge on the wrest plank. 2d, The connexion of the two strings with the same screw when that is combined with the employment of a fret or other rest, merely supporting the string on the sounding board at single points and not confining it."

101. For an *Improvement in Treating Galena or Lead Ore*; Julius E. Schowbe, City of New York.

Claim.—"The method of treating galena by means of common salt, or its chemical equivalent, and sulphuric acid."

102. For an *Improvement in Attaching Hubs to Axles*; Eliphalet S. Scripture, Green Point, New York.

Claim.—"The plate jointed or formed of two parts and provided with flanches, in combination with the shield, collar, and gasket."

103. For an *Improvement in Felting Hat Bodies*; Isaac Searles, Newark, N. J.

Claim.—"The combination of the circular revolving bed with one or more planking tables, and one or more cones."

104. For an *Improved Saw-Set*; Isaac Spaulding, Saratoga Springs, New York.

Claim.—"The construction of the slides and their arrangement with the screws and punch."

105. For an *Improved Horse Collar*; Samuel Shattuc, Henrietta, Ohio.

Claim.—"The key, screw key, and section provided with the projections, and combined with the washer, constituting a jointed collar."

106. For an *Improvement in Sewing Machines*; Isaac M. Singer, City of New York.

Claim.—"The mode of operation for forming seams by alternately making a long forward and then a short back stitch by means of an eye pointed needle, which merely carries a part of its thread through the cloth or other substance, that it may be interlaced or concatenated, whether the said mode of operation be applied, or any equivalent therefor."

107. For an *Improvement in Suckers for Pumps*; Joseph Weis, Bordentown, N. J.

Claim.—"The wedge-shaped block with any convenient number of wings, in combination with the perforated hollow cone and the similarly shaped piece of gum elastic or other similar substance, to be applied as buckets or valves for pumps."

108. For an *Improvement in Locks*; Thomas Bowles, Assignor to Robert M. Patrick, City of New York.

Claim.—"The shutter so arranged, that, being brought into action when the bolt is withdrawn, it shall cover the key hole, while the bolt is so withdrawn. Also, the arrangement for withdrawing the bolt by a distinct movement of the key after the tumblers have been set, such arrangement consisting of the lever, in combination with the link and the bolt."

109. For *Improved Arrangements and Combinations of Machinery for Regulating Velocity of Wind Mills*; Jeremiah Burnit, Assignor to self and James Clark, Puseyville, Pennsylvania.

Claim.—"1st, Causing the vanes or sails to traverse automatically from or towards the centre of the wind wheel. Also, in connexion with the centripetal and centrifugal

traversing of the sails or vanes, the vertical adjustment of the same, viz., causing the double lattices, of which the vanes are composed, to expose more or less surface to the wind by making the slats of one cover more or less the openings in the other."

110. For an *Improvement in Woven Fabrics*; John Healey, Bolton-le-Moors, England, Assignor to James Bishop, New Brunswick, N. J.; patented in England, November 17, 1846.

Claim.—"The improvement in the woven fabric, in which the weft is placed in a diagonal position to the warp."

111. For an *Improvement in Cooking Stoves*; John B. Lancaster, Administrator of John R. Lancaster, deceased, Tampa, Florida.

Claim.—"The arrangement of parts."

112. For an *Improvement in Lamp Extinguishers*; Elijah Richmond, Assignor to Ira Noyes, Abington, Massachusetts.

Claim.—"Attaching to the cap or extinguisher, a tube placed at any desired angle with the same, leaving a clear space between the cap and its tube, whereby the cap or extinguisher can be applied to or removed from the wick without removing the said cap tube from the wick tube."

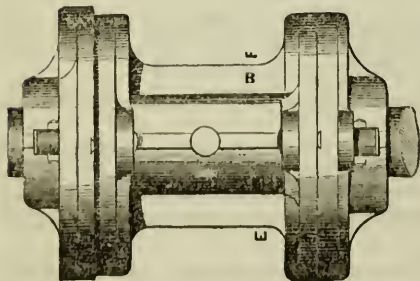
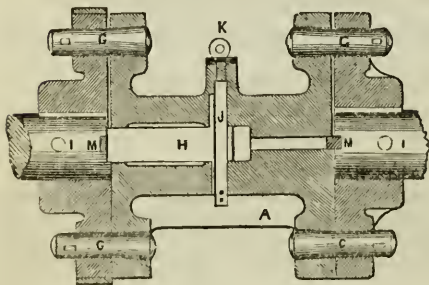
MECHANICS, PHYSICS, AND CHEMISTRY.

*Coupling Screw Propeller Shafts.**

To the Editor of the Artizan.

SIR:—Enclosed I have sent you, for publication in your valuable *Journal*,

Longitudinal Section



Plan.

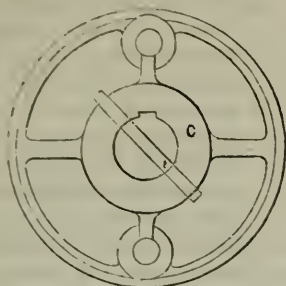
a sketch of a simple plan for coupling screw shafts to $\frac{1}{2}$ -in. scale.

A represents a section of intermediate distance piece, which is intended to be placed between the engine and propeller shaft; B, plan; C, end view of coupling bosses on propeller and engine shafts; D, section through (E, F); G G G G, pins for connecting it to bosses on propeller and engine shafts; H, pin fitted in the inside of intermediate distance piece loose, the one end of which fits into a recess in end of propeller shaft, for the purpose of keeping the surfaces apart when the propeller shaft gets disconnected, to prevent friction that would be caused should the surfaces come in contact; J, cotter, for cotterling up pin, H; I I, pins for preventing coupling bosses from

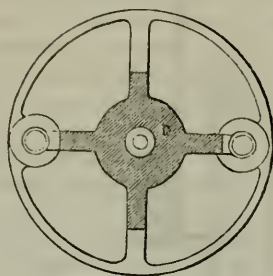
being drawn off when the engines are reversed, and also when the pro-

* From the London Artizan, August, 1855.

propeller shaft is being drawn in, which will have to be done by two long screwed bolts and nuts for that purpose, which are not shown ; *k*, eye-bolt for lifting out intermediate distance piece ; *l*, friction strap for holding or preventing the propeller from revolving whilst being connected or disconnected ; *m m*, pins to prevent the engineers from making a mistake



End View.



Traverse Section.

in putting the intermediate distance piece into its place : these pins are intended to be fitted into grooves, cut in the front surfaces of connecting bosses, extending from edge to centre, as shown ; by that means it can enter but one way.

It is my opinion that if this plan were introduced in the mercantile screw-steamers, it would be the means of saving much time and expense in connecting and disconnecting screw shafts, and prevent injury to the bearings.

*Bellhouse and Cowburn's Oscillating Safety Valve for Steam Boilers.**

A Safety Oscillating Float Valve of similar principle to those herein-after described was invented by Messrs. Bellhouse and Cowburn about two years ago ; since that time they have perfected the idea, and have produced an oscillating safety valve which possesses the merits of being simple, not easily deranged, and certain in its action. One variety of this valve is represented in fig. 1 of the annexed engravings, and consists of a spherical valve *a*, fitted upon a concave seating *b*, on the top of a tube *c*, rising from the boiler. The valve is loaded by annular-shaped weights *d*, dropped over the bell-shaped cover *e*, which is connected by ribs to the spherical valve *a*. The weights thus act directly upon the valve without the intervention of a lever. When the steam rises to a dangerous pressure it affects the valve by imparting to it an oscillating and revolving motion upon its seating, thus forming a lateral crescent-shaped opening between the valve and its seating, which admits of the escape of steam, and at the same time keeps both valve and seating clean and free from tendency to adhesion. The suspension of the weights at a level below the valve itself, causes it to find its own level and adjust itself, should the valve from any cause get out of plumb. This description of valve is further provided with levers and float, so arranged, that should the water in the boiler descend to a dangerous level, the valve will be opened, and the steam will escape.

* From the Lond. Civ. Eng. and Arch. Jour., August, 1855.

In a second variety of this combination of the vacuum and float valve, the steam acts on the upper surface of the valve, which is recessed on

its under side, so as to leave the spherical portion of the valve as narrow as the concave seating on which it is fitted. The valve has a cross-head, to which is attached a forked pendant, which forms one arm of a rigid angular lever, the other arm consisting of a tube in which are balls which act as movable ballast, and assist the motion of the valve by their impetus in rolling to the other end of the tube. A float is attached to the end of the tubular arm, and when the water level descends to a dangerous point the action of the levers causes the spherical valve to slide on its concave seating, thereby forming lateral crescent-shaped openings through which steam will be emitted from the inside of the boiler; or should there be a vacuum in the boiler, air will be admitted from the exterior atmosphere.

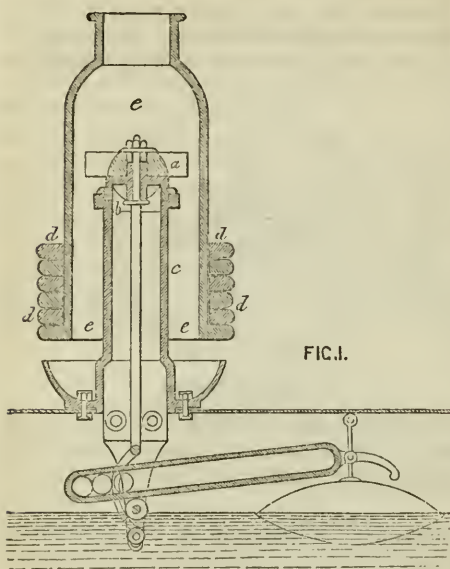
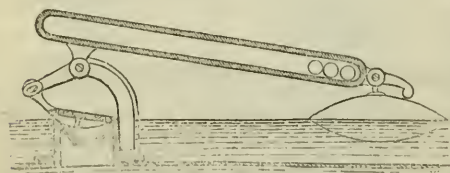


FIG. 1.

FIG. 2.



A third modification of Messrs. Bellhouse and Cowburn's vacuum and float valve is shown in fig. 2. This valve is designed to act under water, being generally placed over the fire-box or flue of the boiler, and acting in a manner similar to those already described, allowing of the escape of the water and steam, or of the entrance of air, as the case may require. The valve may have leaden or other fusible metal plugs, run into tapered holes as shown, which will provide an additional security.

These patent valves are much approved of in Manchester, upwards of 200 of them having been applied to steam and other boilers in that neighborhood, within the last twelve months.

*Removal of Stains of Nitrate of Silver.**

For this purpose the following solutions may be employed:—A solution of 8 parts of perchloride of mercury and muriate of ammonia in 125 parts of water, or one of 5 grms. of cyanide of potassium and 50 centigrms. of iodine in 45 grms. of water.—*Journ. de Pharm. d'Anvers*, October, 1854.

Manufacture of Gas. Patented June 23, 1854. By THOMAS ISAAC DIMSDALE.*

This invention has for its object to increase the volume of the gas obtainable from carboniferous or bituminous substances, by means of a novel mode of applying known chemical principles to the production of gas for both heating and lighting purposes. The production of gas for both these purposes is effected by one continuous operation, and in a simpler, cheaper, and therefore more practical way (consistent with the easy adaptation of the invention to the existing apparatus in gas works) than has hitherto been done. The decomposition of water when heated to various degrees by passing it over incandescent charcoal, to obtain hydrogen gas and otherwise, as auxiliary to these purposes, has not been hitherto effected in a manner to bring the process into anything like general use. One difficulty has been the high value of charcoal, which, by the great majority of experienced gas manufacturers, has been found to render the cost of obtaining the gas, greater than when coals are employed in the usual method.

In carrying out this invention, steam is generated in an ordinary low-pressure steam-boiler, and it is conveyed by a horizontal iron pipe immediately over or under the groups of retorts, as they are now arranged in gas manufactories. This pipe may be well covered with felt, or any substance which is a non-conductor of heat, in order to prevent the steam from experiencing any material loss of temperature during its passage along the pipe. From this horizontal pipe smaller perpendicular short branch pipes, provided with stop-cocks, are made to ascend or descend towards the centre of the retorts. These branch pipes are to be connected, by a screw-joint, with a pipe passing through the lid or top of the retort, along the top inside, then down at the back, where the pipe is divided into three pipes that pass along the bottom. These bottom pipes are perforated with very fine holes underneath, so as to permit the escape of steam, and their ends are closed. When the retorts are not at work, the small perpendicular pipes can be disconnected from the pipes in the retort and taken off; and the stop-cocks close to the horizontal pipe being turned off, all escape of steam will be prevented. The retorts are to be charged, in the usual way, with bituminous shale or schist, boghead, cannel, or ordinary coal, and heated precisely in the manner now done. When the retort has become thoroughly hot, and the mass of the substance within heated through, or nearly through, to a red heat, the stop-cocks communicating with the horizontal steam-pipes are to be turned on, and the steam admitted: the result of this will be, that the steam will become super-heated in its passage through the pipe placed inside at the crown or top of the retort, and after descending through the pipe at the back of the retort, the super-heated steam will ascend through the incandescent mass in the retorts from the small apertures pierced in the lower pipes. The steam will be thereby decomposed, and hydrogen and oxide of carbon gases be evolved, which will combine with and increase the volume of gas being produced by the destructive disillation of the substance with which the retorts have been charged. From bitu-

* From the Lond. Civ. Eng. and Arch. Jour., August, 1855.

minous coal, schist, or shale, a thick heavy gas is produced, rich in illuminating power, and the addition of the hydrogen and oxide of carbon gases, will not materially diminish the illuminating power, and by no means in proportion to the increase of volume they afford. Up to a certain duration of the process (being nearly that at which the operation would cease for making gas under the old and usual mode) the increase obtained in volume will vary in amount, according to the quality of the substance with which the retort is charged, from twenty to thirty per cent., before any apparent diminution of lighting power will occur, or so as to render the gas unsuitable for illuminating purposes. When the decrease in lighting power has reached to this point, the communication between the retorts and the gas holders, which received gas intended for lighting, is to be shut off, and the gas subsequently produced should be conveyed into a separate gas holder, which gas will now be applicable to heating purposes. This gas will be of greater heating power than carburetted hydrogen; and the quantity produced by the continued passage of the super-heated steam through the incandescent mass in the retorts, will amount to more than the volume of the lighting gas transmitted to the first gas holder. Thus, assuming that the quantity of gas which would have been yielded under the old and ordinary process of gas making, to be nine thousand cubic feet per ton of ordinary coal, the quantity suitable for lighting purposes will be increased up to nearly eleven or twelve thousand cubic feet, and the produce from bituminous schist or shale, augmented from five thousand or six thousand to seven thousand or eight thousand feet; and the quantity of gas for heating purposes yielded besides, will be at least an equal quantity more. If the material to be carbonized be peat, lignite, or other carbonaceous substance, yielding gas of feeble illuminating power, it may be saturated previous to being put in the retort, or partly saturated, with any dissolved resinous, oleaginous, or fatty matter, or a proportion of boghead coal mixed therewith, with or without such saturation, and then heated in the manner above described. The ash or charcoal of boghead coal or shale, which has been perviously used and exhausted of all the gas it will yield suitable for lighting, may be again used for producing gas for heating. The charcoal obtained from lignite, peat, or wood, when in an incandescent state, being capable of decomposing the steam of water, may all be used in the above described manner for that purpose; and if the gas be required for illuminating purposes, it may be carburetted by putting into the retort with these matters, dried peat in small lumps, or pulverized sawdust, or ground charcoal saturated with any oleaginous, fatty, resinous, or tarry matter, or with naphtha. The fatty, oleaginous, resinous, or tarry matters should be mixed with the dried peat, sawdust, charcoal, or other solid carbonaceous substances, before the latter are placed in the retort, and not added thereto while in the retort.

Claims.—The method described, of operating upon carbonaceous or bituminous substances (capable of yielding combustible gas for lighting and heating), by the introduction into the retort, during the process of distillation, of jets of super-heated steam, for the purpose of decomposing the same, and causing its elements to combine in a nascent state with the gases evolved from the carbonaceous or bituminous substances contained

in such retort. Also, mixing with solid carbonaceous matters, as above set forth, fatty, oleaginous, or resinous substances, previous to the same being placed in the retorts, for the production of gas.

*Aluminium, the so-called New Metal.**

Marvels (if we may judge from the eager manner in which they are received by the bulk of mankind) are the natural food for the sustenance and quickening of many minds. There are few among us who cannot testify to the charm of a really marvellous story. It is indeed quite vexing, while soaring pleasantly in imagination, far from facts and figures, to be brought suddenly, by some friendly monition, into the presence of stern realities, and thereby convinced that we have been merely dreaming. If, however, we do not desire to have our visions thus rudely dispelled, we must choose for our ruminations some field which will not admit of the facile demonstration of the impracticable or impossible. In short, it is injudicious, whatever custom may say to the contrary, to feed the marvellous vein of craving humanity with fictions based upon supposititious progress made in the applied sciences; and that for the simple reason that the deceit, whatever it may be, is so readily discoverable. This, we think, is well understood by all persons engaged in practical science; for whatever class else of the community may take on trust the announcements of wonderful discoveries put forth from time to time, whether they relate to flying machines, the long range, or perpetual motion, we are sure it is not the followers of chemistry or mechanics who place the slightest faith in such fictions. They, however, are subject to fall into an error of an opposite kind, and distrust the value of every suggestion that has not been put to actual trial. This is more especially the case when very important advantages are declared to be attainable by the adoption of some new proposition; for knowing, by experience, how gradual has been the progress in the arts, practical and scientific men are unprepared for great changes; and thus, from their discrediting unattested statements, many valuable discoveries have long been kept in abeyance.

The recent proposition for the adoption into the arts of the metal aluminium, has afforded to the lovers of the marvellous a new subject for speculation. Already its adaptability to a hundred cases is proclaimed, although the difficulty of obtaining it is at present a bar to its use. It is sufficient that the compounds of the metal are capable of being reduced and made to yield the pure metal; that the metal thus obtained is white, tough, not readily oxidizable, and has a lighter specific gravity than iron: and from these facts a world of probabilities as to its ultimate range of application, has been put forth. We remember, some years ago, when the great and unexpected yield of copper at the Burra Burra mines affected, for a time, the market price of that metal, the public was promised penny-pieces as large as dinner plates. But, far from that, copper has actually advanced in price, and that to a permanent and inconvenient degree; while gold—notwithstanding the prophecies respecting the change which the enormous additions made to it of late

* From Newton's London Journal of Arts and Sciences, September, 1855.

years would effect in its market price—still retains its relative value amongst the metals, and has hitherto, as far as we remember, found no new application in the arts to the displacement of any other metal; although its natural peculiarities render it eminently adapted to a variety of untried uses. We are led to make these remarks in order to abate public expectation respecting the prominent position that aluminium will quickly take in our manufactures. When a ready means has been found to obtain the metal at a price, numerous difficulties may even then present themselves, and call for the exercise of great ingenuity and patience to master them. This was the case with zinc, which, although well known to the ancients, and employed for so many centuries in the production of alloys, has only of late come into extensive use, owing to the difficulties which had to be encountered in its manipulation. But while many enthusiasts are busy in extolling the merits of aluminium as the latest treasure wrested from the store-house of nature, we think it not unlikely that those whose interest its discovery may most nearly concern, will, instead of testing its value by experiment, ignore its very existence until it has forced its way into notice. It is just one of those discoveries which no manufacturer could afford to pursue at his own expense, and for the simple reason that he would gain no equivalent for his labor, because all would participate alike with him in the benefit of his researches. We are glad, therefore, to find that the French Government, in its provident care for the advancement of science, has been at the cost of a series of experiments for ascertaining the best means of reducing aluminium from its compounds to the metallic state. It is at present premature to pronounce an opinion as to the future value of this metal in the arts; but as nothing can give a greater impetus to manufacturing industry in its present advanced state than the introduction and use of new natural products, we propose to lay before our readers the gleanings of the foreign journals, which treat of the properties of aluminium, and the mode of obtaining it from its natural combinations.

This metal, which, owing to the recent researches of M. St. Claire Deville, is now exciting so much attention, was discovered, or rather, its existence was inferred, by Sir H. Davey; and the correctness of his inference was confirmed by M. Wohler, who obtained aluminium in a pulverulent state by treating its chloride with potassium. By modifying M. Wohler's process, says M. St. Claire Deville, the decomposition of the chloride may be regulated in such manner as to produce a degree of incandescence that will cause the particles of the metal to agglomerate and take the form of globules. On heating a mass, composed of the metal and chloride of sodium (which is to be employed by preference,) in a porcelain crucible, to a lively red heat, the excess of chloride of aluminium will be disengaged, and a saline mass, with acid re-action, will remain, in which will be found globules of perfectly pure aluminium. This metal is as white as silver, and eminently malleable and ductile. Nevertheless, on working it, it is found to offer greater resistance than silver; and it is therefore supposed to approach nearer to iron in tenacity. It increases in hardness by being worked, but will regain its former condition by the annealing process. The melting point of aluminium approaches that of silver: its density is 2.56: it may be

melted and run off in the open air without undergoing any perceptible oxidation; and it is a very good conductor of heat.

Aluminium is not affected by exposure to either dry or damp air; neither does it tarnish; but it remains perfectly bright, where freshly-cut zinc and tin lose their lustre. It is not affected by the action of sulphuretted hydrogen, nor by hot or cold water. Nitric acid, either weak or concentrated, and weak sulphuric acid, when employed in the cold state, do not act upon it. Its true solvent is hydrochloric acid, from which it disengages the hydrogen, and sesquichloride of aluminium is formed. When heated to redness in hydrochloric acid, in the gaseous state, the product is a dry and volatile sesquichloride of aluminium.

It will be easily understood that a metal which is as white and unchangeable as silver, which is not tarnished by exposure to the air, and which is fusible, malleable, ductile, and tenacious, and possesses the singular property of being lighter than glass, would be exceedingly useful if it were possible to obtain it easily. Besides, considering that this metal exists in nature in large quantities, and that its ore is clay, it is much to be desired that the means should be found for bringing it into common use. The investigations of M. St. Claire Deville have led him to hope that this might be the case, as the chloride of aluminium is decomposed with remarkable facility at a high temperature by the common metals: and a re-action of this nature, which he is striving, with the encouragement of the French Academy of Arts, to realize on a larger scale than a mere laboratory experiment, will solve the question in a practical point of view.

In a subsequent report, made by M. Deville, to the Academy of Arts, he observed that he had caused medals of large size to be struck in aluminium, and also prepared plates of the same, which were not affected by exposure to the air;—and further, that small ingots of the same metal, although handled daily, were found to retain their brilliancy; in fact, this substance was so inoxidizable, that it resisted the action of the air even when heated in a muffle to the temperature employed for assaying gold.

Aluminium will not form an amalgam with mercury, and it takes up but a very small quantity of lead. With copper, it forms light alloys, which are very hard and white, even when 25 per cent. of copper is used. It also has the peculiarity of forming with carbon a grey casting, which is granulous and brittle, very easily crystallizable, and containing silicium, which is separated therefrom in a state of purity, on continuing the action of boiling hydrochloric acid.

The following are two methods given by M. St. Claire Deville, for obtaining this metal:—

I. *Sodium process.*—Introduce into a glass tube of about an inch in diameter, from 200 to 300 grammes of chloride of aluminium, closing the ends with a plug of asbestos; then conduct hydrogen gas, dry, and perfectly free from atmospheric air, into the tube, and heat the chloride of aluminium in this current of gas by means of charcoal. This will have the effect of driving off the hydrochloric acid, chloride of silicium, and chloride of sulphur, with which it is always impregnated. Capsules of as large size as possible, containing each some grammes of sodium,

previously crushed between two sheets of dry filter paper, are then introduced into the glass tube. The tube being full of hydrogen, the sodium is melted; and the chloride of aluminium on being heated, will be distilled and decomposed with incandescence, which may be easily moderated. The operation will be complete when all the sodium has disappeared, and the chloride of sodium formed has absorbed a sufficient quantity of chloride of aluminium to saturate it. The aluminium will now exist in the state of a double chloride of aluminium and sodium, which is a very fusible and volatile compound. The capsules are next to be removed from the glass tube, and placed in a large porcelain tube, furnished with a pipe leading to a receiver. Through this porcelain tube, while heated to a lively red heat, a current of hydrogen, dry, and free from air, is caused to pass; and the chloride of aluminium and sodium will be thereby distilled without decomposition, and collect in the receiver. After the operation, all the aluminium will be found collected in the capsules in the form of large globules: these are washed in water, which will carry off a little of the salt produced by re-action, and also some brown silicium. In order to form a single mass of all these globules, after being cleansed and dried, they are introduced into a capsule of porcelain, into which is put, as a flux, a small quantity of the product of the preceding operation—i. e., of the double chloride of aluminium and sodium. On heating the capsule in a muffle to the temperature of about the melting point of silver, all the globules will be seen to unite into a brilliant mass, which is allowed to cool, and then washed. The melted metal must be kept in a closed porcelain crucible until the vapors of the chloride of aluminium and sodium with which the metal is impregnated have entirely disappeared. The metallic mass will then be found surrounded by a light pellicle of alumina arising from the partial decomposition of the flux.

II. Process by means of Galvanism.—This process is carried on by means of the double chloride of aluminium and sodium. For this purpose the aluminium bath is prepared by taking two parts by weight of chloride of aluminium, and adding thereto one part of dry pulverized marine salt. The whole is mixed in a porcelain capsule, heated to about 200 degrees. The combination will soon take place, with disengagement of heat. The liquid thus obtained is to be introduced into a capsule of glazed porcelain, which is maintained at a temperature of about 200 degrees. The negative electrode is a plate of platinum, upon which the aluminium will be deposited, mixed with marine salt, in the form of a greyish layer. The positive electrode consists of a porous vessel, perfectly dry, and containing melted chloride of aluminium and sodium, in which is immersed a cylinder of charcoal, which generates the electricity, and to which pass the chlorine, and a small quantity of chloride of aluminium arising from the decomposition of the double salt. The double fixed chloride is re-constituted, and the vapors cease. A small number of elements are necessary for decomposing the double chloride, which presents but slight resistance to the action of electricity.

When the platinum plate is sufficiently charged with metalliferous deposit, it is removed, and allowed to cool: the saline mass is then cleaned off, and the plate again introduced into the current. The mat-

ter thus detached from the electrode is melted in a porcelain crucible, which is enclosed in an earthenware one; and after cooling, it is treated with water, which dissolves a large quantity of marine salt; and a grey metallic powder is obtained, which is, by several successive meltings, formed into a single mass; the double chloride of aluminium and sodium being employed as a flux for that purpose.

The first portions of metal obtained by this process are nearly always brittle: as fine a product may, however, be obtained by it as by the sodium process; but the chloride of aluminium employed for that purpose must be purer. In fact, by the sodium process, the silicium, sulphur, and iron are carried off by means of the hydrogen,—the iron passing off in the state of protochloride; whilst all these impurities remain in the liquid which is decomposed by the battery, and are carried off along with the first portions of metal reduced.

In addition to these processes of M. Deville, we are enabled to add—*M. Bunsen's method of preparation.*

Take oxide of aluminium, obtained either by the calcination of ammoniacal alum, or from sulphate of alumina, or by the decomposition of alum by chloride of barium; and having mixed it with charcoal, introduce the mixture into a stone retort capable of containing about two quarts, and cover it with a thick layer of cement composed of argil and iron scales. Place the retort in a reverberatory furnace, with its neck projecting horizontally therefrom, from three to five inches, and connect this neck with a glass receiver, for the reception of the chloride of aluminium which is sublimed on the introduction of chlorine. This gas is introduced into the glass receiver by a tube of large diameter, made of glass not easily fusible. The stone retort is heated to a dull red heat, and a current of chlorine (well washed and dried) is caused to pass therein. Chloride of aluminium is then freely formed; and at the expiration of some hours the receiver will contain at least half a pound of product. When this chloride has well cooled, it is mixed with its equivalent of melted and pulverized chloride of sodium, and heat is applied thereto. The mixture will melt at a temperature below 200° Centigrade. It is introduced into a closed porcelain crucible divided into two compartments by a porcelain partition which does not quite reach to the bottom, and closed by means of a porcelain cover, having two holes for the reception of the conductors of the battery. Six or eight pairs of Bunsen's plates will suffice to separate the aluminium. If the temperature remains at 200° Centigrade, the metal will be deposited in the state of powder; and, for the purpose of converting this into a compact mass, pulverized chloride of sodium is gradually introduced into the mixture until the liquid has reached the temperature of the melting point of silver. After cooling, large balls of aluminium will be found in the mass, which are caused to unite by throwing them into melted sea salt. The ingots thus obtained possess all the characteristics of M. Deville's aluminium.

These processes, it will be understood, are suited rather for the laboratory than for the requirements of the arts: but we hope ere long to be able to present our readers with a more practicable plan for obtaining an abundant supply of the metal.

"Improved Double-action Force Pump." By ROBERT AYTOUN.*

The inventor's attention was drawn to this subject in consequence of the bad performance of the common double-action force-pump, which was generally found to be inoperative in the up-stroke, from the presence of air. He stated that he had succeeded in the present machine in rendering the presence of air harmless, and in making both down and up-strokes completely effective, at the same time that the machine itself is more simple and less cumbersome. It consists of an ordinary plunger working through a stuffing box fixed upon the end of a working barrel. The area of the cross section of the working barrel is double that of the plunger. Attached to the lower end of this plunger, and working in the barrel, is an ordinary lifting bucket with valves. Below the working barrel is a stationary valve, and below this, again, is the suction pipe. Near the top of the working barrel, a bent pipe leads to the bottom of the stand of pumps. The action of the pump is as follows:—The plunger being forced through the stuffing box into the barrel, displaces its own bulk of water, and sends it through the bent tube into the stand of pipes; while the lifting bucket, descending with open valves, allows the whole contents of the working barrel to pass through and to get upon its upper side. On the return stroke the whole water in the working barrel is raised by the lifting bucket. One-half of this water serves to fill up the void caused by the simultaneous withdrawal of the plunger, and the other half escapes, as before, through the bent tube into the stand of pipes. Thus a quantity of water is raised at each half stroke of the engine exactly equal in bulk to the plunger. As the upper part of the working barrel where the stuffing-box is situated has at all times a free communication with the water in the stand of pipes, without the intervention of any valve, it is plain that no air can leak through the stuffing-box into the working barrel; and if any air enter through the suction pipe, or wind bore, it will at once rise to the top of the working-barrel, where it will assist by its elasticity in maintaining a continuous flow of water, until it finds its way through the stuffing-box into the atmosphere.

Mr. LANDALE, M. E., rose and made some remarks in favor of Mr. Aytoun's pump, which, he said, had been lucidly described. It was a pump admirably suited for many purposes, particularly where it could be got at readily, for renewal of cluck and bucket, such as shafts of moderate depth, where the water would not flow over the working parts, and where the pump rods were neither long nor heavy—where they were so, the single plunger was preferable, because the column of water to be lifted balanced the rods. In many situations where the engine was near the pump, and in inclined mines under ground, it was an excellent contrivance, and simple in its parts, and a vast improvement over the old four-valve double-action solid plunger pump, which was a troublesome customer, and very often lost the water on one side, and was being very generally abandoned about collieries. Mr. Landale said, however, that although he knew his friend Mr. Aytoun had really invented it, yet it was not new, as he had had it from Mr. Nelson, of Hyde Park, London, some four years before, and he believed that gentleman had got

*From the Lond. Civ. Eng. and Arch. Journal, September, 1855.

it from some water-works in England, which he could not now name; but it could be easily got at. Mr. Landale also pointed out one similar in principle, recommended in the *Glasgow Mechanic's Magazine*; but it having two sets of rods, two barrels, and too small an area suction cluck, it could not be at all compared with the simplicity of Mr. Aytoun's pump. But neither were new; both he and his brother had been familiar with them for years.

For the Journal of the Franklin Institute.

Particulars of an Iron Steamer.

Hull built by Reaney, Neafie & Co., Philadelphia, Pa. Machinery by the same. Intended service, carrying passengers and freight on the Pacific Coast and Rivers.

HULL.—

Length on deck, ...	128 feet.	
Breadth of beam, ...	19 "	6 inches.
Depth of hold, ...	7 "	
Length of engine space, ...	43 "	
Draft—estimated forward, ...	4 "	
" " aft, ...	4 "	3 "

ENGINES—Two—Inclined cylinders—placed fore and aft.—

Diameter of cylinder, ...		29 inches.
Length of stroke, ...	3 feet.	
Maximum pressure of steam in pounds, ...	30.	
Cut off from commencement of stroke, ...		18 "

BOILERS—Two—Flue and return flue.—

Length of boilers, ...	16 feet.	
Breadth "	6 "	
Height " exclusive of steam drum, ...	7 "	9 inches.
Cubic feet in steam drum, ...	110 "	
Number of furnaces, ...	2.	
Breadth "	4 "	9 "
Length of grate bars, ...	5 "	6 "
Number of flues, ...	12 in each.	
Internal diameter of flues, ...		5½ "
Length of flues	11 "	6 "
Heating surface, ...	425 cubic feet in each, 850 sq. "	in both.
Diameter of chimney—one, ...	3 "	
Height "	33 "	

PADDLE WHEELS—of iron.—

Diameter over boards, ...	18 "	6 inches.
Length of blades, ...	5 "	3 "
Depth "		15 "
Number "	16.	
Dip of wheels, ...	2 "	3 "
Average revolutions per minute, estimated, ...	22.	

Remarks.—Frames $2\frac{3}{4} \times 2\frac{3}{4} \times \frac{3}{8}$ inches and 18 inches apart; 8 strokes of plates from keel to gunwale. Thickness of plates, $\frac{3}{8}$ and $\frac{1}{4}$ inch. Two bulkheads; two box kelsons of wrought iron plates 15 inches high. Valves are worked by Stephenson's link motion. Cabins fitted up with berths for 30 passengers.

The joiner work and plating of hull are entirely fitted, but not fastened, being, what is technically termed, "a knock down," that the parts may be shipped to San Francisco, California, and there set up.

W. J.

For the Journal of the Franklin Institute.

Particulars of an Iron Steamboat.

Hull built by Reaney, Neafie & Co., Philadelphia, Pa. Machinery by the same. Intended service, for carrying freight and passengers on one of the Rivers on the Western Coast.

HULL.—

Length on deck, ...	100 feet.	
Breadth of beam, ...	19 "	
Depth of hold, ...	6 "	
Draft of water forward, estimated, ...	1 "	6 inches.
" aft, "	1 "	6 "

ENGINES—Two—horizontal.—

Diameter of cylinder, ...		14 inches.
Length of stroke, ...	3 feet.	
Maximum pressure of steam in pounds, ...	65.	
Cut off from commencement of stroke, ...	2 "	6 "

BOILER—One—flue and tube.—

Length of boiler, ...	17 feet.	
Breadth "	5 "	3 inches.
Height " exclusive of steam drum, ...	7 "	
Cubic feet in steam drum, ...	38½.	
Number of furnaces, ...	1.	
Breadth of furnace, ...	4 "	10 "
Length of grate bars, ...	5 "	
Number of flues or tubes, ...	36.	
Internal diameter of flues or tubes, ...		2½ "
Length of flues or tubes, ...	12 "	
Heating surface, ...	520 sq. "	
Diameter of smoke pipe, ...	2 "	
Height "	25 "	

PADDLE WHEEL—at the stern —

Diameter, ...	15 "	
Length of blades, ...	12 "	
Depth "		12 inches.
Number "	13.	
Dip of wheel	1 "	3 "
Average revolutions per minute, estimated, ...	25.	

Remarks.—Frames, $\frac{5}{8} \times 2\frac{3}{4}$ inches by 1 feet 8 inches apart ; 7 strakes of plates from keel to gunwale. Thickness of plates $\frac{1}{4}$ and $\frac{5}{16}$ inch. The bottom stiffened with two wrought iron plate box kelsons 15 inches high.

This boat will run in connexion with the above mentioned, and is, also, a "knock down," intended for shallow river navigation.

The boiler is an arch forward; the engines are on deck, aft, in the usual way for stern-wheel boats.

W. J.

For the Journal of the Franklin Institute.

Particulars of the Steamer Antelope.

Hull built by Samuel Hall. Machinery by Boston Steam Engine Co., Otis Puffit, agent. Intended service, Japan to China.

HULL.—

Length on deck from fore part of stem to after part of stern post above the spar deck,	155 feet.	
Breadth of beam at midship section,	27 "	6 inches.
Depth of hold to spar deck,	10 "	6 "
Length of engine and boiler space,	36 "	
Draft of water at load line,	12 "	
" below pressure and revolutions,	10 "	
Tonnage, (custom house,)	415.	
Contents of bunkers in tons of coal,	75.	
Masts and rig,	brigantine.	

ENGINES—Vertical direct.—

Diameter of cylinders,		30 inches.
Length of stroke,	2 feet	2 "
Maximum pressure of steam in pounds,	25.	
" revolutions per minute,	58.	

BOILERS—Two—return flued.—

Length of boilers,	23 feet	6 inches.
Breadth " each,	7 "	
Height " exclusive of steam chimney,	8 "	6 "
Number of furnaces,	2.	
Breadth " "	2 "	11 "
Length of grate bars,	6 "	9 "
Internal diameter of flues,	5 upper of	13 "
	8 lower of	9 "
	2 "	18 "
Length of flues,	18 "	4 "
Diameter of smoke pipe,	3 "	6 "
Height " "	22 "	
Description of coal,	anthracite or bituminous.	
Combustion,	natural draft.	

PROPELLERS.—

Diameter of screw, (Griffith's,)	9 feet.
Pitch " "	19 "
Number of blades,	2.

Remarks.—Floor timbers, at throats, *molded* 12 inches; *sided* 10 inches. Distance of frames apart, at centres, 24 inches. Floors filled in solid; water tight bulkheads fore and aft. C. H. H.

*Coloring of Stone.**

Building-stone may be tinted in different shades by impregnating it with metallic salts, and then adding a precipitating re-agent. By means of salts of lead and copper, with sulphuretted hydrogen, greys, browns, and blacks may be produced. Copper and ferrocyanide of potassium give a red tint. If porous limestones are boiled in solutions of metallic sulphates, carbonic acid is evolved, and the metallic oxide, combined with sulphate of lime, is deeply fixed in the stone. In this manner,

* From the Lond. Artizan, Sept., 1855.

sulphate of iron gives rusty tints, sulphate of copper a fine green, sulphate of manganese a brown, and mixed sulphates of iron and copper a chocolate. The double sulphates thus formed increase the hardness of the stone.

For the Journal of the Franklin Institute.

Particulars of the Steamer Fulton.

Hull built by Smith & Dimond, New York. Machinery by Morgan Iron works, New York. Intended service, Norfolk to Havre.

HULL.—

Length on deck from fore part of stem to after part of stern post above the spar deck, ...	280 feet 5 inches.
Breadth of beam at midship section, (<i>molded</i>), ...	42 "
Depth of hold, ...	24 "
do. to spar deck, ...	31 "
Length of engine and boiler space, ...	114 "
Draft of water at load line, ...	16 "
" " below pressure and revolutions, ...	16 "
Tonnage	2500.
Area of immersed midship section at this draft, ...	630 sq. feet.
Contents of bunkers in tons of coal, ...	700.
Masts and rig, ...	Brig.

ENGINES.—Inclined oscillating, placed fore and aft.

Diameter of cylinders, ...	65 inches.
Length of stroke, ...	10 feet.
Maximum pressure of steam in pounds, estimated 20.	
Cut-off at	1½.
Maximum revolutions per minute, estimated 18.	

BOILERS.—Two—Vertical Tubular—placed fore and aft.

Length of boilers, ...	30 feet.
Breadth "	12 "
Height " exclusive of steam chimney, ...	14 "
Number of furnaces, ...	7.
Breadth of furnaces, ...	3 " 6 inches.
Length of grate bars, ...	7 "
Number of tubes in each boiler, ...	2500 in after, 1900 in forward.
Internal diameter of tubes, ...	2500 of 2 in. and 1900 of 2½ in.
Length of tubes, ...	3 feet.
Heating surface, ...	9300 sq. feet.
Diameter of smoke pipe, ...	6 feet 8 inches.
Height, ...	41 "
Description of coal, ...	Bituminous or Anthracite.
Combustion, ...	Natural draft.

PADDLE WHEELS.—

Diameter, ...	34 feet.
Length of blades, ...	9 "
Depth "	24 inches.
Number, ...	28.

Remarks.—Floor timbers at throats, *molded* 20 ins.; *sided* 10 ins. Distance of frames apart *at centres* 32 ins. Diagonal and double laid iron straps $4\frac{1}{2} \times \frac{3}{4}$ inches. Engines and boilers inclosed in water tight bulkhead.

On Nature Printing. By MR. H. BRADBURY.*

Mr. Bradbury's lecture was very long and interesting—and of that special kind which is most difficult to condense. His history of experiments in the art was especially elaborate. He said:—"Nature herself, in her mysterious operations, seems to have given the first hint upon the subject: witness the impressions of ferns so beautifully and accurately to be seen in the coal formations. Experiments to print direct from nature were made as far back as about 250 years—it is certain that the present success of the art is mainly attributable to the general advance of science and the perfection to which it has been brought in particular instances. On account of the great expense attending the production of wood cuts of plants in early times, many naturalists suggested the possibility of making direct use of Nature herself as a copyist. In the 'Book of Art,' of Alexis Pedemontanus, (printed in the year 1572,) and translated into German by Wecker, may be found the *first* recorded hint as to taking impressions of plants. At a later period—in the 'Journal des Voyages,' by M. de Moncoys, in 1650, it is mentioned that one Welkenstein, a Dane, gave instructions in making impressions of plants. The process adopted to produce impressions of plants at this period, consisted in laying out flat and drying the plants. By holding them over the smoke of a candle, or an oil lamp, they became blackened in an equal manner all over; and by being placed between two soft leaves of paper, and by being rubbed down with a smoothing-bone, the soot was imparted to the paper, and the impression of the veins and fibres was so transferred. Linnæus, in his 'Philosophia Botanica,' relates that in America, in 1707, one Hessel made impressions of plants; and between 1728 and 1757, Prof. Kniphof, at Erfurt, who refers to the experiments of Hessel, in conjunction with the bookseller Fünke, established a printing-office for the purpose. Seligmann, an engraver at Nuremberg, in 1748, published in folio plates figures of several leaves he had reduced to skeletons. As he thought it impossible to make drawings sufficiently correct, he took impressions from the leaves in red ink, but no mention is made of the means he adopted. Of the greater part he gave two figures, one of the upper and another of the lower side. About from twenty-five to thirty years later, Hoppe edited his 'Ectypa Plantarum Ratisbonensium,' and also his 'Ectypa Plantarum Selectarum,' the illustrations in which were produced in a manner similar to that employed by Kniphof. These impressions were found also to be durable, but still were defective. The production of impressions could only take place very slowly, as the blacking of the plants with the printer's ball required much time. Rude as the process was, and imperfect the result, it was nevertheless found that the figures thus produced were far more characteristic than any which artists could produce. The fault of the method consisted in its limited application and its incompleteness; since the fragile nature of the prepared plant, if ever so carefully treated, would admit of but very few copies being taken, and where any great number would have been required, many plants must have been prepared, a circumstance which was in itself a great obstacle. In the year 1809 mention is made in Pritzell's

*From the London Athenæum, June, 1855.

'Thesaurus' of a new method of taking natural Impressions of Plants; and lastly, in reference to the earlier history of the subject, the attention of scientific men was called to an article, in a work published by Grazer, in 1814, on a 'New Impression of Plants.' Twenty years afterwards, the subject had undergone remarkable change, not only in the mode of operation to be pursued, but also in the result produced,—which consisted in fixing an impression of the prepared plant in a plate of metal by pressure. It appears, on the authority of Prof. Thiele, that Peter Kyhl, a Danish goldsmith and engraver, established at Copenhagen, applied himself for a length of time to the ornamentation of articles in silver ware, and the means he adopted were, taking copies of flat objects of nature and art in plates of metal by means of two steel rollers. Various productions in silver of this process were exposed in the Exhibition of Industry held at Charlottenburgh, in May, 1833. In a manuscript, written by this Danish goldsmith, entitled 'The Description (with forty-six plates) of the method to Copy Flat Objects of Nature and Art,' dated 1st of May, 1833, is suggested the idea of applying this invention to the advancement of science in general. The plates accompanying this description represented printed copies of leaves, of linen and woven stuffs, of laces, of feathers, of birds, scales of fishes, and even of serpent skins."—Passing over a great deal of intervening ground; we come to Mr. Bradbury's conclusion and summary:—"The first practical application of Nature-Printing for illustrating a botanical work, and which has been attended with considerable success, is Chevalier Von Heufler's work on the Mosses collected from the Valley of Arpasch, in Transylvania; the second, (the first in this country,) is the 'Ferns of Great Britain and Ireland,' in course of publication, under the editorship of Dr. Lindley, and printed by Messrs. Bradbury & Evans. Ferns, by their peculiar structure and general flatness, are especially adapted to develop the capabilities of the process, and there is no race of plants where minute accuracy in delineation is of more vital importance than the Ferns; in the distinction of which, the form of indentations, general outline, the exact manner in which repeated subdivision is effected, and most especially the distribution of veins scarcely visible to the naked eye, play the most important part. To express such facts with the necessary accuracy, the art of a Talbot or a Daguerre would have been insufficient until Nature-Printing was brought to its present state of perfection." Mr. Bradbury then adverted to the ingenious and beautiful productions of Felix Abate, of Naples. His Nature representations consist of sections of wood, in which the grain is admirably represented. He terms his peculiar process Thermography, or the Art of Printing by Heat. The process consists in wetting slightly the surface of the wood of which fac-similes are to be made, with any diluted acid or alkali, and then taking an impression upon paper, or calico, or white wood: the impression is quite invisible, but by exposing it for a few instants to a strong heat, the impression appears in a more or less deep tone, according to the strength of the acid or alkali. In this way every gradation of brown from maple to walnut is produced; but for some woods which have a peculiar color, the paper, &c. is to be colored, either before or after the impression, according to the lightest shades of the wood. Abate, in his manipulations, also employs the ordi-

nary dyeing process. It is to be hoped that Abate's process may become alike useful to the natural sciences and the decorative arts. Mr. Bradbury stated, in conclusion, that we are indebted to—Kniphof, for the application of the process in its rude state; Kyhl, for having first made use of steel rollers; Branson, for the suggestion of the electrotpe; Leydolt, for the remarkable results he obtained in the representation of flat objects of mineralogy, such as agates, fossils, and petrifications; Haidinger, for having promptly suggested the impression of a plant into a plate of metal at the very time the *modus operandi* had been provided; Abate, for its application to the representation of different sorts of ornamental woods on woven fabrics, paper and plain wood; Worrying, of the Imperial Printing Office, Vienna, for his practical services in carrying out the plans of Leydolt and Haidinger. Nature-Printing may be considered as still in its infancy; but the results already obtained in its application encourage us to expect from continued efforts such further improvements as will place it not least among the Printing Arts.

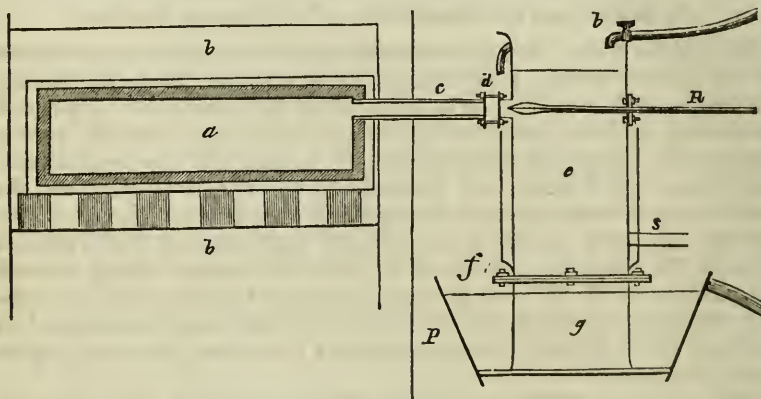
On Sodium and its Manufacture. By WILLIAM BEATSON.

Having for some years given considerable attention to the production of the alkaline metals, I have succeeded in obtaining them (particularly sodium) in such quantities, as to show that it only needed the demand to be created, and they could be supplied in such a way, as would greatly promote the application and extension of science and the chemical arts, and it was only because that demand did not appear to exist, that the subject was allowed to remain in comparative abeyance. Now that such interest has been excited in the enlarged application of Mr. Wohler's process, for preparing aluminium by means of sodium, chiefly through the exertion of M. St. Clair Deville, it may not be uninteresting to indicate the means by which this latter metal, sodium, may be extracted by enlarged and improved processes, which I have been led to employ for some time past.

The retorts, in which the mixture of carb. soda, and coke, has been heated, have been chiefly of malleable iron; but, as it is difficult to obtain these of a large size, retorts of earthenware or fire-clay have been used with success, and probably a fire-clay retort, with a lining or trough of malleable iron, will be found to be the best form of distilling apparatus, though with great care cast iron retorts may yet be employed with advantage. The principal improvement which I have effected, and which is now engaging the attention of M. Deville, consists in making the process continuous; so that the retort is maintained at nearly a uniform temperature, and only requires the introduction of a fresh charge when the previous one has been worked off. If the materials are properly proportioned, the retort becomes nearly empty at the termination of each distillation; or, if an excess of carbon remains in the retort, it is available in the following operation, so that in this way one retort has been kept in full action for a week, and sometimes for nearly a second week, without interruption. As soon as one distillation is completed, and the condenser removed, a fresh charge of soda and carbon is introduced into

the retort, through the same tube as emits the sodium, by means of a long semicircular scoop, and the retort being nearly filled, the new distillation commences in a short time, and proceeds with the greatest regularity and success; the sodium which I have sent to the Paris exhibition, was prepared in this way, and, as before stated, it was only because there seemed to be no demand for the metal, that it was not prepared on an industrial and extensive scale; perhaps, as in some other instances, the supply may create or excite the demand. In addition to the sodium, it is well known that a large quantity of croconates and other compounds of soda distil over and are found mixed with the sodium, and as their separation is tedious in small quantities, I have constructed a large iron cylinder, in which the sodium and its impure admixtures are heated to fusion, below the surface of naphtha or camphine, and a piston or plunger being then forced down by a powerful screw or hydraulic press, the pure metal is found in a mass above, and the impurities in the bottom of the cylinder.

The subjoined figure will explain the method of continuous distillation:—



(a) Retort of iron, inside of fire-clay. (b) Chamber of reverberatory furnace. (c) Eduction tube, attached by screws at (d) to the iron receiver (e), which is made in two parts, screwed together, and cemented at (f), the lower part (g), containing naphtha or camphine. (h) Tap supplying cold water, which by means of an external case circulates round the condenser (e), falling into the pan (P). (R) Is a strong iron rod, with sharpened steel chisel at the end, for clearing out the eduction tube (c). (s) Escape tube for incondensable gases.

The Chemist.

Rotherham, August 14th, 1855.

*De Tremblay's Mixed Steam and Ether Engine.**

Some years ago the scientific world of London was astonished by the exhibition of a steam engine on an improved principle, in which, by the substitution of certain preparations instead of water, the working cost was

*From the London Mining Journal, No. 1048.

reduced nearly fifty per cent. Whether any thing has been done in this country by the public or the Government we have not heard, but we have received authentic information from Marseilles, that the Societe de Navigation Mixte have just paid 40 per cent. as the present dividend on their original stock, the market price of these shares (nominally of 500 frs. each, but upon which only 133 frs. have been paid) is 650 frs. The subscription list for an issue of increased capital closed on the 10th inst., and the deposit of 50 frs. per share was paid; they are now quoted at 100 frs. premium. All the vessels of this company are engaged in the transport service of the French Government. It would thus appear, that English steam navigation companies are now to be added to railways, and may gain a lesson from the French.

For the Journal of the Franklin Institute.

Mechanical Engineering as applied to Farm Implements. By H. HOWSON, Civ. Eng.

(Continued from page 405, Vol. XXX.)

In connexion with agricultural implements, there is a class of inventions, which, although trifling and unimportant in appearance, are well worth a place in these papers, as demonstrating to what an extent and in what minute appliances ingenuity and practical skill have been developed in perfecting various instruments indispensable to the pursuits of husbandry.

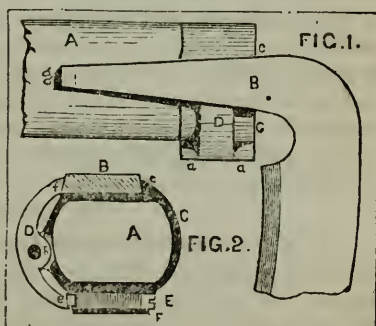
In this class may be placed the numerous devices for fastening the blades of scythes to their snaths.

It may appear somewhat singular that for performing this simple operation there should be no less than eighteen or twenty patented contrivances; such is the case, however, and doubtless an examination of the rejected model department of the Patent Office, would divulge the fact that an equal if not greater number of applications for patents for scythe fasteners have been unsuccessful.

In the annexed engraving, Fig. 1 represents a plan, and Fig. 2 a transverse section of a

Scythe Fastener. Patented by B. F. Joslyn, Worcester, Mass., Aug. 1855.

A is a portion of the snath; B, the shank of the blade, having its edges slightly bevelled, and having at its end a projection which fits snugly into a recess in the snath; c, is a hoop shrunk or otherwise secured to the end of the snath, A. On the bottom of this hoop is the lug F, for receiving the tightening screw E. Two other lugs a a, are formed on the side of the hoop between which and on the central pin c, is the lever D, the end e, of one arm coinciding with the end of the screw E, and the end f of the other arm being shaped to correspond with the bevel of the shank



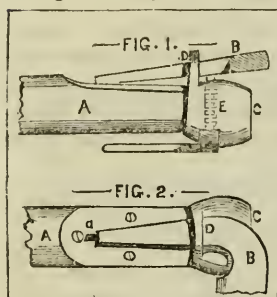
B, which rests on the flat top of the hoop c, and is confined when secured in its proper position between the point F of the lever D, and the beveled lip c, on the hoop c, the tightening of the screw E, serving through the action of the lever D, to bind the shank hard against the lip c, and the beveled edges of the latter as well as of the point F of the lever, preventing the shank from rising out of its place when thus bound. The superiority of this scythe fastener over others, as claimed by the patentee, is set forth in the following quotation from his specification:

"It will be seen that the shank may be firmly secured to, or removed from the hoop c, on the snath, with the greatest facility by the point of the screw being simply forced against, or withdrawn from the point of the lever; the whole arrangement dispensing with the necessity of boring holes in the hoop (thereby destroying its integrity), and without cutting or otherwise wounding the portion of the snath surrounded by the hoop, both which defects are common to other scythe fasteners."

Annexed are two views of

A Scythe Fastener. Patented by S. B. Bachelor, in February, 1854.

Fig. 1 being a side view, and Fig. 2 a plan.



A, is the snath; B, the shank of the blade which passes through an eye D, in the hoop c. A hook or projection at the end of the shank fits into the longitudinal slot a, in the plate or spotting on the snath. E, is a screw passing through the hoop c, and binding with its point against the shank in such a manner as to secure the latter firmly to the snath. The advantage claimed by the inventor is that gained by the use of the longitudinal slot a, in the spotting which enables blades with shanks of various lengths to be easily attached to the snath.

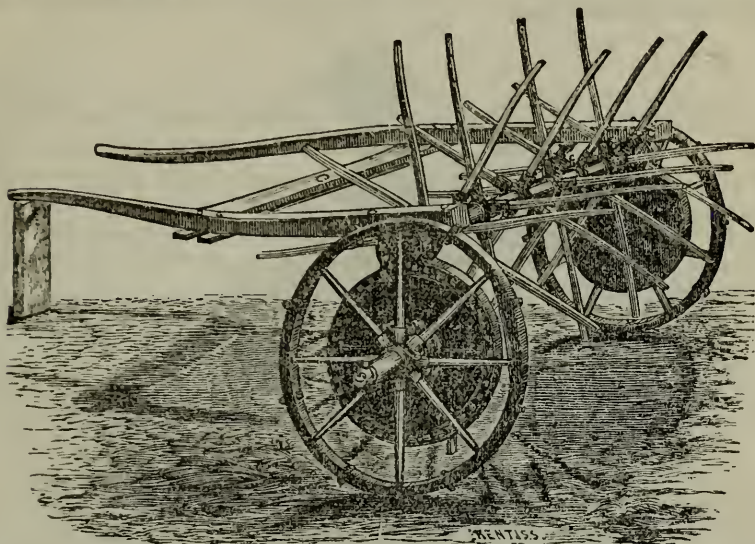
There are various other devices for effecting the object accomplished by the above; devices equally as ingenious, and doubtless, as effective in practice; the two contrivances selected, however, afford an ample illustration of the purport of this class of inventions, and will suffice to show to what minute details the talents of the ingenious have been directed in endeavoring to perfect the most common farm implements.

Thousands of these little attachments are manufactured yearly in Massachusetts alone, to be forwarded to every part of the Union, and when it is considered that a saving of half an hour in the construction of each, would, in the manufacture of one thousand, be, at a moderate calculation, a gain of sixty or seventy dollars, it ceases to be a matter of astonishment, that these seeming trifles should have received so much attention at the hands of ingenious mechanics.

Hay Making Machines.

Hay making machines have for some time been more or less used in different countries in Europe; they have found but little favor, however, among the farmers of the United States. The machine represented in the accompanying perspective view has been employed to some extent in some of the Northern States, and operated with considerable success.

This implement, which has been remodeled from an English machine, and considerably simplified, consists of a pair of substantial shafts suitable for one horse. To the end of each shaft is secured an iron casing, each casing containing a spur wheel and pinion gearing into each other. The pinions are secured one to each end of a stout wooden bar, which



has its bearings in the above mentioned iron casings. On the bar are secured six or more iron sockets a convenient distance apart, each socket having four recesses for receiving a similar number of wooden arms. The spur wheels into which the pinions gear, are loose on stationary axles which project from, and are secured to the iron casings. On the same stationary axles are the main or driving wheels, which have projections from their peripheries, in order to prevent them from slipping off the ground. The driving wheels are so arranged in connexion with the spur wheels that both move simultaneously, so that on drawing the machine over the ground, the spur wheels cause the pinions and the bar on which they are secured, together with its arms, to revolve, and toss whatever mown grass they come in contact with high into the air, thereby distributing it lightly and evenly over the surface of the ground. The machine is made remarkably light and cheap, costing only thirty dollars, and is calculated to spread an acre of hay in twenty minutes.

That every farm implement should be cheap, simple, and at the same time have but little liability to get out of repair, is absolutely necessary. More futile efforts and abortive schemes have resulted from want of attention to the above requisites in designing and constructing agricultural machinery, than any other cause. The constant changes of the weather, the variations of temperature to which such implements are continually exposed, and the class of laborers into whose charge they are frequently placed for operation, dictate the advantages of the most rigid simplicity and durability of construction.

Corn Planters. Patented by Mr. Wakefield, in July, 1854.

Mr. Wakefield has certainly complied with these requisites in designing his ingenious corn planters, which are now manufactured by Messrs. Pascal Morris & Co., the extensive builders of farm implements in this City, and at Reading.



The apparatus as shown in the hand of the operator in the annexed sketch, consists of a light but strong wooden box, which forms the hopper containing the seed to be planted. In front of the box is a guide frame for directing the up and down movement of the embedding bar, which is furnished at the top with a handle for the operator. A partition near the bottom of the instrument separates the hopper from a receiving chamber, and above this partition is a transverse slide, operated by the motion of the embedding bar, on the descent of which the slide allows a fresh supply of grain to drop from the hopper to the receiving chamber, and at the same time the bar ejects the charge of corn previously fed into the chamber, and embeds it in the soil. A projecting flanch at the bottom of the instrument, prevents its planting point from entering too deep into the ground. The operator uses the apparatus as he would an ordinary walking stick, stepping from hill to hill, and striking the point into the ground at the required intervals, and thereby imparting to the embedding bar an up and down movement, by which the hole is made, the seed fed down, and deposited, the seed box closed, and the seed covered with the soil. To explain distinctly the method of performing these several operations, would require explicit detail engravings; suffice

it to say that the whole contrivance is neat, simple, and seems in every respect well adapted for the purpose intended.

The inventor declares, that with his hand planters, one man will plant four times as much corn, rice, beans, peas, &c., as four men depositing the seed by hand and covering with hoes.

(To be Continued.)

Description of a new Moulding Machine for Cog and other Wheels. By
MR. PETER ROTHWELL JACKSON, Manchester.*

The difficulty that the writer experienced in the course of his practice in not being able to find wheels for driving machinery exactly suited in form, strength, and speed, to the purposes required, (a difficulty that has been extensively felt, notwithstanding the very large and costly stock of wheel patterns existing in this country,) led him, some years since, to investigate the subject with a view to discover if some mode of construction could be adopted which would enable the founder to make cog-wheels from a simple segment of two, three, or more teeth, of any diameter, pitch, breadth, or shape of tooth, without the use of the pattern, in the ordinary way. The result is the machine which is the subject of the present paper.

The process hitherto adopted for making the best cog wheels, (whether spur or bevel-wheels) has been to construct an entire pattern of wood, an exact fac-simile of the wheel to be cast,—having each tooth formed and shaped upon it with great care. In all cases this involves a considerable expenditure, besides requiring very careful stowage till the pattern is next needed; but in the case of large wheels, this becomes a serious consideration, particularly the time required for preparing the pattern, which causes a great addition to the loss and inconvenience occasioned when an accident happens to one of the wheels in a factory,—thereby stopping a large portion of the machinery.

It will be seen that the plan now submitted enables the founder to produce wheels in the shortest possible time, and with a degree of accuracy which is quite unattainable in the usual way, in which patterns are often made in a hurry of imperfectly seasoned timber, and are rarely true, even for a short time; and unless made from timber that has had years to season, constructed with the greatest care, and carefully stored, they soon become valueless.

The proper form of teeth, which, in every case, should depend upon the dimensions of both the wheels which are to work together, can seldom be obtained in the ordinary way, owing to the great expense of good patterns. This often leads to the adoption of a form of tooth which is but an approximation to that degree of truth which is readily attainable by the plan now submitted.

It has often been found that wheels of the same pitch and breadth, but from different makers, will, on this account, not work well together: this difficulty has sometimes been got over by a hand process of chipping and filing (commonly termed pitching and trimming); but such a process,

* From the *Journal of Arts and Sciences*, August, 1855.

besides the great objection in regard to expense, involves the inaccuracy inevitably attaching to hand work, and has also the objection of removing the hardest and best portion of the metal.

The nearest approach to accurate construction in this direction was, the writer believes, the attempt (formerly made by Mr. Brunton, of Soho), to shape the teeth by a slotting machine, the tool of which was guided by a template of the desired tooth.

To obviate the difficulties that have been referred to, the writer conceived the idea of providing the foundry with a machine capable of producing, with great accuracy, a short segment of pattern, and also of moulding, with equal accuracy, from the segment thus produced, the entire circumference of the wheel required.

This machine consists of a vertical spindle, which carries a circular horizontal table or face-plate, and works in a conical bearing formed in the centre of the frame. The foot of the spindle is separated by four diagonal struts, which extend downwards from the frame, and support the weight of the table, and any thing that may be put upon it, by means of a foot-step, by which the table can be raised at pleasure in the conical bearing in the upper frame,—thereby enabling the workman to turn the table round with very little force and perfect steadiness, though bearing great weight upon it.

Upon a horizontal slide-bed, attached firmly to one side of the frame, moves, by means of a rack and pinion, a sliding jib, which carries at its extremity a vertical slide. On the lower end of this slide the block of wood, out of which the pattern of the teeth is intended to be produced, is fixed; and provision is made for holding it perfectly steady during the operations of cutting the teeth and of moulding, and also for fixing the pattern true and square on any subsequent occasions.

On the under side of the circular table a worm wheel is fixed, for moving round the table, by means of a worm and shaft and change wheels, similar to an ordinary dividing or wheel-cutting machine.

The worm and worm wheel are constructed with great accuracy, and are protected from injury and exposure to any dust of the foundry by a waterlute, consisting of a vertical ring cast upon the under side of the table, and revolving in a small circular trough of water attached to the plate of the lower frame.

By turning the worm shaft the required number of times (having previously adjusted the change wheels so as to suit the number of teeth in the wheel intended to be moulded), the circular table is turned round an interval equal to the pitch of the wheel; and this movement can be accurately repeated in succession through any portion of the circumference.

A block of wood for the segment patterns having been fixed upon the vertical slide, and the slide adjusted at the required distance from the centre of the table, the change wheels also having been arranged to suit the required number of teeth, a cutter is fixed in a horizontal spindle, which revolves in a stand fixed upon the main table at the correct distance from the centre of the table corresponding to the radius of the intended wheel. This cutter is made to revolve rapidly; and the pattern block is then moved down gradually by the vertical slide until a parallel cut is obtained through the entire block—forming one space in the pat-

tern. The block is then raised ; and by turning the table round the distance of the pitch, and repeating the cut by passing the slide down again before the cutter, another space is formed ; which operation is repeated until all the required spaces are cut in the segment pattern.

The pattern is made to terminate at somewhat less than half a tooth on each side ; and a thin metal shield is fixed on each end in the direction of a radius of the circle, projecting about an inch beyond the crown or point of the tooth, for the purpose of preventing the moulder, in the subsequent process of moulding, from disturbing the teeth that he has previously formed in the sand. The formation of the short segment pattern being completed, the cutter and stand are removed, and a moulding box is placed on the table.

In the conical hole in the centre of the table is fitted a bush, in which an upright spindle works,—the purpose being for measuring from it the diameter of the wheel, and for strickling or levelling the sand in the moulding box to form the bottom of the mould of the intended wheel, previous to commencing the moulding of the teeth.

The moulding of the teeth is performed in the following manner:—The segment pattern is depressed until it rests upon the levelled sand forming the bottom of the mould,—the top of the segment being level with the edge of the box ; and it is there held firmly. The moulder then rams up, in the ordinary way, that portion of the box opposite the segment pattern, and withdraws the pattern : he then turns the table through a space equal to the number of teeth contained in the segment pattern, and lowers the pattern again, rams up the mould in the fresh position of the box, and so repeats the process until the entire circumference of the wheel is moulded.

In sliding down the pattern into each fresh position, it is prevented from disturbing any portion previously moulded, by its not actually touching the sand ; and the shield-plates on each end of the pattern prevent any risk of injury in the process of ramming. These plates leave a narrow channel in the sand—causing a small fin on the centre of the crown of the tooth at that position, which is chipped off by the dresser after casting.

The moulding of the cogs (the essential part of the mould) being thus completed, the box can be removed from the machine, and the moulder can proceed with another wheel, whilst other hands place the cores in the mould already formed. The spaces between these cores form the arms of the wheel, and the centre of the wheel is cored out in the ordinary way : the rim of the wheel is formed by the spaces left between the outer extremities of the cores, and the sand forming the teeth ; and the boss or nave is formed by the space between the centre core and the inner ends of the cores.

The top box, having the lower edge turned, is rammed up on a true surface-plate, forming simply a flat top to the mould ; and when placed upon the bottom box, the upper edge of which is also turned, and is on a level with the upper surface of the intended wheel, the sand being strickled off to the edge, forms a perfect joint, and, with the cores before named, completes the mould for the wheel.

Bevelled wheels are made by the same system on the machine, from a short bevel segment pattern ; to produce which a peculiar cutter-stand is used, admitting of adjustment to any desired bevel ; by which, and the machine, the operator is enabled to impart a correct spacing, and very nearly complete the entire segment. The pattern for a bevelled wheel is lifted vertically out of the sand in the same direction as a spur-wheel, and does not slide in the direction of the inclined teeth, on account of the tapered form of the teeth.

Racks can also be made by this machine from a few cogs, by attaching a dividing-screw and change wheels to move the sliding-jib and vertical slide, and fixing the pattern block at right angles to the face of the slide by an angle bracket, so as to mould the rack in a line parallel with the slide-bed.

For moulding very large wheels extending beyond the range of the apparatus, the sliding-jib and carriage are removed altogether, and a horizontal arm fixed on the revolving table, carrying at its outer extremity the pattern slide, which is then moved round by the dividing gear, instead of the moulding box being moved,—the operation of moulding taking place in a circle round the machine. The cutter-stand, for cutting the pattern, in this case is fixed upon the ground, at the proper distance from the centre of the machine, and the pattern is made to move past the cutter, instead of the cutter moving from space to space of the pattern as before.

The following advantages are experienced in moulding by this machine: Each wheel being made from a pattern of its own, specially adapted to work into its fellow, and not with reference to any other wheel, the general principle that any two wheels should have the particular form of teeth that will work best together, can be strictly carried out without difficulty, and at a trifling cost.

The accuracy that has hitherto been with difficulty obtained, even in the best patterns, is by this machine strictly imparted to the sand itself. The teeth, however long or broad, can be drawn out of the mould without any taper allowance whatever, and the workman's attention being directed to a few teeth only at a time, he is more likely to give them special care. The time not unfrequently spent in what is called mending the mould, but which, in fact, from the difficulty of guiding the hand, is too often found to impair the correctness of the work, is thus saved. The result is the production of spur and bevel gear of so much greater accuracy than has been produced by other means, that they can be run at a higher speed than has been hitherto considered advisable in heavy gearing. There is also less need for mortise-wheels, as the noise of gearing proceeds principally from too much clearance, and the want of truth in the teeth.

This plan of moulding allows of **H** spokes, with flanches round the inner edge of the rim, being adopted, as readily as the ordinary **+** or **T** section of spoke. The **H** spoke makes a stronger wheel, but is not easily obtained by the old system.

Spur-wheels, with shields or flanches to the crown or pitch line, are made with greater facility than by the ordinary process of moulding, as the lower shields are more easily withdrawn, owing to the absence of sand in the centre of the mould.

The large, and in some cases valuable fire-proof buildings, erected for the stowage of wheel patterns, will, by the adoption of this process, be saved, as one machine gives a greater range of pattern than the largest stock contains. This method is useful in enabling the founder to match exactly any old wheel, whether the same have parallel or taper teeth, by forming a short segment pattern to work with it with the greatest correctness practicable, and without having to adapt or modify any previous pattern. It may also be observed, that the breakage of a wheel generally implies a deficiency in strength for the work it has to do; but with the old pattern, the strength cannot well be increased.

In order to show in how short a time a wheel can be produced by this process, an instance may be mentioned of a spur-wheel, for which the following order was sent to the author, by telegraph, from Bristol, on 1st December last:—

“One spur-wheel, twenty-eight cogs, two feet three diameter at pitch-line, cogs two and a quarter long, eight inch broad, six and five-eighths round eye, cast, four arms. Send by rail immediately. Write.”

This order was received at the writer's works at 3 $\frac{1}{4}$ o'clock in the afternoon. The tin template, steel cutter, and segment to the right size, pitch, and number of cogs were produced; the wheel was moulded and cast, weighing 6 $\frac{1}{2}$ cwt; and after remaining five hours in the sand, was taken out and dressed, carted nearly two miles, and forwarded by the Bristol train, which left Manchester at half-past nine o'clock the following morning; being a total time of 18 $\frac{1}{4}$ hours,—13 hours being the actual time of making the wheel.

—

Mr. Jackson exhibited a series of specimens of patterns for spur and bevel-wheels, made by the machine, from $\frac{3}{8}$ -inch to 4 $\frac{1}{2}$ inches pitch, and extending to 16 inches in breadth, with the steel cutter used for forming the teeth of one of the patterns, and the tin template from which the cutter was shaped; also a cast wheel, 2 feet 3 inches diameter, that had been moulded on the machine.

He explained, that after having moulded the teeth of a wheel, the further completion of the mould, by inserting the cores for the centre and arms, could either be done on the machine, or after the box was removed, as might be most convenient. Sometimes the wheel had been cast whilst the box remained on the machine, but generally the box was removed as soon as the teeth were moulded, to allow another wheel to be proceeded with, and four or five wheels were sometimes on the floor at once, ready for casting at night, all moulded by the one machine during the day. The core-box for the arms was simple in construction, being made with two sides only, fixed at the required angle, determined by the number of arms, and having an adjustable end and bottom, to suit the different diameters and breadths of wheels.

The Chairman said, he had seen the machine at Mr. Jackson's works, and was much struck with the great accuracy with which the moulding of the teeth was accomplished, the motion of the slide being quite parallel and steady, so that the pattern was drawn out without risk of disturbing the sand. Before seeing the machine, he feared some practical difficulty

in insuring accuracy of the pitch at the several joinings of the pattern; but this was completely provided for by the whole movement of the table, both in moulding and in cutting the pattern, being given by the same dividing wheel, which could be constructed with any degree of accuracy. The machine appeared an excellent mechanical arrangement for obtaining a degree of accuracy in the sand, superior to the ordinary process of moulding; and he thought the work must be truer than in any wheels cast from a pattern built up of pieces. He inquired what was the velocity of the cutter employed in forming the segment pattern, and whether the cutter finished the pattern sufficiently smooth for use.

Mr. Jackson replied, that the cutter was driven at about 1000 revolutions per minute, and the teeth of the pattern were completed at once by the cutter, and not touched by hand, except what was requisite for varnishing the pattern, which was done to protect it from injury by moisture. The cutter was driven by a cord, stretched tight by a sliding-pulley and weight, to allow for the different positions upon the table, required for cutting patterns of different diameters.

He further explained, that in the cutting of bevel-wheel patterns, a cutter, shaped for the small end of the teeth, was used in the same manner as in cutting the patterns for spur-wheels, except that the pattern block was held stationary, and the sliding motion given to the cutter, in a direction corresponding to the inclination of the cone of the intended wheel, by an adjustable slide. The same slide could also be adjusted to carry a second cutter, revolving at right angles to the main cutter, which would finish the ends of the teeth, by cutting them off at proper angles to the face, and at the required length—the cutter-frame being made to travel round with the circular table. The teeth of the pattern were thus pitched out accurately by the machine, and finished at the small ends; and the spaces removed by the cutter were then widened and deepened to a uniform taper towards the other or large ends of the teeth; these large ends being first accurately marked out, by placing, instead of the first steel cutter, a tin template, accurately fitting into its place, and shaped to the correct form, for the large ends of the teeth: this template was then brought down upon each space of the segment pattern in succession, by means of the dividing wheel, and the exact pitch and outline of each tooth carefully scribed from the template.

Mr. Hodgkin asked, whether the teeth of the pattern were dressed by hand to the required taper.

Mr. Jackson said that some part of the work of shaping the teeth in bevel-patterns only was done by hand, but the accuracy of the pattern was not affected, as the man had only to dress them off to a straight edge between two given points, since the teeth were accurately pitched, and cut complete at the smaller end, by the machine; and the position of the template employed for marking out the larger end of each tooth, must in each case truly coincide with the previous position of the cutter, in forming the small end of the tooth, on account of the same movement of the dividing wheel of the machine being employed for the purpose in both cases.

The Chairman suggested the adoption of some different arrangement

of cutter, to enable the tapered teeth to be entirely shaped by the machine, as it was advisable to avoid, if possible, any dependence upon hand-work in forming the pattern.

Mr. Rainsbottom observed that the curve of the tooth in a bevel-wheel being different at every portion of its length, on account of the whole tooth being tapered both in breadth and depth, caused the difficulty in cutting by machinery, as no cutter could be passed through in the ordinary way, except the one fitting the small end of the tooth.

Mr. Jackson said that an ingenious arrangement had been made by Mr. Bodmer, to shape the teeth in bevel-wheels, by means of a long conical cutter, revolving on an axis parallel to the teeth, instead of at right angles to them, and pointing always truly to the apex of the cone of the wheel; the outer end being guided to the required shape of tooth by an enlarged template. Such a cutter might give a pretty correct form to the teeth throughout their length, if the true taper of the sides of the cutter, to the centre of the cone, could be always maintained; but, in his opinion, there were great practical difficulties in its application.

In answer to an inquiry as to the expense of moulding by the machine, as compared with the ordinary mode of moulding cog-wheels, when there was a pattern already made, Mr. Jackson said there would be little difference; his bevel-wheels, moulded by the machine, were about the ordinary price, and spur-wheels rather under;—spur-wheels were supplied by him then at about 13s., and bevel-wheels at about 17s. per cwt. In using the machine, it was unimportant whether the pattern had to be made or not, as the cost of a segment pattern was very small: the smaller sizes were produced for about 3s. 6d. each, including the cutter.

Mr. Fernie inquired what plan was followed in determining the form of curve for the teeth. He thought the machine appeared one of so much importance, and gave such facility for the correct formation of the pattern, that the advantage of the best theoretical form of tooth might be obtained in all the wheels, without regard to existing patterns.

Mr. Jackson said he made any form of tooth that might be desired, and often had to form a special shape in the case of making a wheel to replace an old one; the teeth of the new wheel being modified so as to accommodate it in the best manner that was practicable to the actual form of teeth of the fellow wheel with which it had to gear.

The Chairman suggested that the form of teeth recommended by Professor Willis, and so completely worked out by him, might be advantageously adopted,—and the machine certainly gave an important superiority in enabling wheels to be cast with the form of teeth best adapted to the particular purpose for which each wheel was required, without being confined by the limits of ordinary patterns.

Mr. Jackson said, the plan he adopted for the form of the teeth, when left to himself, was one suggested to him by Mr. Bodmer, which was to employ true epicycloid teeth, by cutting wood templates to the curves of the particular circles in each case, and rolling them upon one another—tracing the true curve by a steel point, attached to the one circle upon a tin template fixed upon the other. The true curve for a single tooth was thus obtained without hand-work, or the usual approximation by arcs of circles; and the steel cutter was then accurately fitted to the

outline traced on the tin template—this being, in fact, the only hand-work in the whole process; the subsequent action of the machine insured a perfect copy of the form of the cutter in every tooth.

Mr. Hawkes thought the machine was very ingeniously contrived, and would certainly produce very accurate work: he wished to know whether the time required for moulding the wheels was longer than by the ordinary process.

Mr. Jackson replied, that the time of moulding was about the same in the case of small wheels: the teeth of a three feet wheel, either spur or bevel, would be moulded in about three hours by the machine. In the case of large wheels, the moulding might be done quicker with an entire pattern than by the machine, by several sets of men being employed at once round the wheel; but in the use of the machine, an important saving of time was found in practice, from the circumstance that the necessity for mending the mould was avoided; which often caused considerable delay in the ordinary moulding, and, however skilfully performed, the repaired part could never be so satisfactory as the rest of the mould.

Mr. Hawkes asked, whether in the case of a large number of wheels, say 100, being ordered from the same pattern, it would be considered preferable to make an entire pattern, or still to mould them with a small segment; and suggested, for such cases, the applicability of a modification of the machine, adapted to draw the whole pattern at once, in a similar manner to the plan adopted with the segment pattern.

Mr. Jackson said, such a case had not occurred at present, as the machine had been mostly employed for making single wheels; but in such a case, a larger segment of the pattern might probably be employed, or even an entire pattern, if the wheel were of moderate size. A machine might doubtless be made to lift any sized pattern, but there would be great difficulties in carrying it out practically; and with the present machine the process of moulding the teeth was so simple and certain that it was effected with great rapidity. The moulding could be done with a segment of a single tooth with equal accuracy, but time would be lost, and the general practice was to have from three to seven teeth in the pattern. The machine had been in operation for eight or nine months, and about 170 spur and bevel wheels had been moulded upon it.

The Chairman inquired what increase of speed was anticipated by Mr. Jackson as practicable in heavy gearing, in consequence of the superior accuracy in the teeth of the wheels moulded by the machine.

Mr. Jackson thought it was very difficult to assign a limit to the speed: if the teeth of the wheels were really accurate, he thought a velocity of 5000 feet per minute might be attained, in the circumference of heavy wheels, with the improved teeth obtained by the machine. He had found very considerable increase of speed practicable in many cases where new wheels, moulded by the machine, were substituted for old ones that had broken. In a rolling mill that he was acquainted with, some of the old wheels had about $\frac{1}{8}$ -th inch clearance, and badly-shaped teeth; and when he had put some new wheels, moulded by the machine, into their place, a great difference in the smoothness of the motion was experienced. He was confident the great imperfection in the teeth caused, in some cases, an irregularity to be communicated to the motion, and a serious loss of

power in heavy machinery; and a much higher speed might be safely attained by proper construction of the teeth than was generally considered practicable. He had been much struck by seeing, in a spinning mill, at Alsace, in France, the whole of the self-acting mule spindles, which were running at 4000 revolutions per minute, driven by cog-wheels in place of bands: there was of course a shrill sound in the rooms from so many thousand wheels, but there was no excessive noise such as to prevent the voice being heard. He was convinced, by the examination of that machinery, that accuracy of construction in the teeth was alone wanted to render practicable, with cog-wheels, any speed likely to be required in machinery. These wheels were of iron, cast from metal patterns very carefully made.

The pattern was rapped gently during the time of drawing it up, by striking with a light hammer on a block of wood held upon the top of the pattern. He had anticipated some difficulty from the sand adhering to the pattern, but was surprised to find the clearness with which the pattern drew from the sand.

Mr. Ramsbottom said, he had seen the machine in operation, and there appeared to be no difficulty in drawing the pattern without injury of the mould, on account of the teeth being perfectly parallel and vertical. This correctness arose from the circumstance that the pattern was cut in the same position in which it was moulded, and by means of the same sliding movement that was afterwards made use of to draw it out of the sand; and, consequently, the motion must be absolutely parallel to the face of the pattern. Any inclined position of the slide would cause the pattern to be cut and also drawn from the sand at exactly the same inclination. The action of the machine was certainly very perfect and satisfactory, and it appeared to be very successful in its operation.

The Chairman said, the machine appeared to be a very ingenious and successful improvement in the process of moulding cog-wheels, and of great practical importance.

TWENTY-FIFTH MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.*

Opening remarks on the objects of the Section. By the CHAIRMAN.—It was intended to combine the theoretical and practical parts of the science of mechanics for popular use. It had long been a general prejudice that these two departments were inconsistent with each other, because few persons combined the two. A chair had been established in Glasgow, fifteen years ago, by the Crown, for teaching the theoretic and practical mechanics combined; but even under the professorship of Mr. Lewis Gordon, the attendance was so small, that the chair was discontinued. The prejudice had now to a great extent disappeared. Last session the chair was resumed, and secured a large attendance, who all showed great anxiety to profit by the lectures. A more suitable place could not be found for the discussion of these subjects, than within the walls of a university so closely associated with the name of Watt. Another object of the Section was to take into consideration the laws affecting inventions,

*From the Lond. Athenæum, September, 1855.

and for urging them on the attention of Government, in which it had already been very successful.

Provisional Report on the Strength of Iron Plates. By Mr. FAIRBAIRN. —Mr. Fairbairn stated that he had been unable to complete the experiments under different temperatures, but so far as they had gone they were very satisfactory. Mr. Hopkins had gone far to discover whether it was liquid or solid at the centre of the earth. They had gone so far as a pressure of 104,000 lbs. on the square inch. He hoped to be able to finish the experiments by the next meeting of the Association.

Provisional Report on Boiler Explosions. By Mr. FAIRBAIRN, who said he had not been able as yet to make many experiments, but had a boiler made so as to determine not only the proportionate strength of boilers, but also to offer suggestions for their management. Their boiler was 17 feet in diameter, with two internal tubes, 3 feet in diameter. It had stood a pressure of 80 lbs. on the square inch, but at 100, one of the tubes collapsed. Their object was to discover a means of proportioning the strength of all the parts. It was also desirable to discover something as to the elastic force of steam, and its properties.—In reply to a question, Mr. Fairbairn said he had investigated no less than a dozen explosions, and there was in the press a series of papers, stating, so far as he knew, the causes. Sometimes they arose from gross negligence, but he believed the majority arose from excess of steam; and it was desirable to be able to proportion the strength of all the parts.

Mr. RENNIE having taken the chair,—

On Practical Tables of the Pressure and Latent Heat of Vapors. By the PRESIDENT :—A paper illustrating a new method of drawing up tables for calculating the amount of heat required to expand steam and other vapors so as to fill a given space. The paper was of too technical a character to be given here, but the fundamental formula is, “The latent heat of evaporation of one cubic foot, of a given fluid, at a given temperature, is the product of the absolute temperature by the rate of variation of the pressure with the temperature.”

On the Transmission of Time Signals. By Mr. C. P. SMYTH.—Mr. Smyth gave a minute description of the manner in which the time-ball on Nelson's Monument in Edinburgh, and the machinery connected with it, are constructed and managed. He directed attention to a model, which was connected with the wires of the electric telegraph by a wire from the Royal Exchange, erected at the expense of Sir Thomas M'Dougall Brisbane. At five minutes to one, two minutes to one, and at one o'clock, the time was communicated from the Royal Observatory in Edinburgh, and indicated by the model. He said Sir Thomas Brisbane was one of the most earnest promoters of the erection of time-balls at the harbors of Glasgow and Greenock, having on his many voyages been convinced of the imminent peril and numerous shipwrecks which arose from the want of correct chronometers for ascertaining the longitude. It was shown by the Greenwich experiments, that there was no inaccuracy to be apprehended on so short a distance as between Edinburgh and Glasgow.

On Practical Details of the Measurement of Running Waters by Weir

Boards. By Mr. JAMES THOMPSON,—Which would require diagrams to render the explanations intelligible. The principal point made out by Mr. Thompson was the value of a certain form of weir board, and he demonstrated that the edge should be reduced to the thinnest possible degree.

A conversation took place, in which Dr. ROBINSON, of Armagh, Mr. RENNIE, and other gentlemen joined.—At the conclusion, Mr. James Thompson was required to draw out his paper in full, that the facts he had elicited might be available for reference to engineers.

Prof. THOMSON explained the construction of an improved air-pump, the invention of a working man, Mr. James Laing. The principal peculiarity was, dispensing with the valve, two pistons being placed in one cylinder, so as to act as valves to each other.

Report of the Inventors' Fund and Patent Laws Committee. By the EARL OF HARROWBY.

On the Operation of the Patent Laws. By Mr. J. MACQUORN RANKINE.—He said the new patent laws have produced some benefits, as simplifying the means of procuring patents, the division of payments, and the speedy publication of new patents, &c. But he thought the facility with which patents are granted is an objection, as furnishing a means for foolish inventors to take patents under the new law; as also the fact, that as patents are provisionally registered for three months, the public cannot know what the character of a new invention is, and therefore more than one or two persons may take a patent for the same invention. Mr. Rankine pointed out several defects in the law of patents. The scope of the paper was to induce the Section to move for a reform in these laws.

On Artillery and Projectiles. By Mr. W. B. ADAMS.—Mr. WARD read this paper, which gave a description of various kinds of projectiles, and the philosophical reasons why gun-cotton is better for blasting rocks than for gunnery. The first guns in use in all countries were long; but the inconvenience of very long guns was the cause why the length was curtailed, and why also carronades and mortars were invented. The paper then went on to describe the material of which artillery should be made, and the proper mode of manufacture, and an improved trunnion, with some original suggestions regarding the form of wadding and shot best suited to give sure aim and increased velocity and penetration. In giving his idea of the best form of a ball, Mr. Adams thought that the conical form, with feathers, was the best, which is exactly that which Mr. Kennedy, of Kilmarnock, has lately patented, and which has been experimented upon lately at Ardrossan and Troon. The idea of an elongated ball, which should also be charged like a bomb, has also been anticipated by Mr. Kennedy. Welded guns, united by hydrostatic pressure,—the coating inside with another metal to prevent abrasion,—and several other improvements, which have in part been adopted by inventors, were also recommended.

Dr. ROBINSON was of opinion that feathers upon a ball was a mistaken idea, because the ball carries with it a portion of air, and that rotation could not be secured to the ball by feathers, alone, as they could not act but on the body of air which they carried with them. Rifled guns are

more liable to burst, because the force necessary to explode a ball from such a piece of ordnance, is much greater than that required for a plain bored gun; and also that a rifled gun is much more liable to burst or be rendered useless from frequent discharges, because of the force necessary to cause rotation having to be added to that which causes projection. Dr. Robinson alluded to the bronze guns of the Dardanelles, which are of three feet bore, used against our fleets not many years since, and which were made by Mohammed II., and asked whether bronze might not now be used instead of cast iron. He suggested the probability that on experiment, railway iron might be found better than cast iron for ordnance.

Mr. FAIRBAIRN said the material of which guns were made was not so good as it was fifty years ago. He was present at Woolwich this week, and saw the practice of the guns there. One of them seemed properly moulded in every part; but it was found that the welding in one part was not sound, and the gas getting into the fracture operated just like a wedge, and split it as if it had been made of paper. Another was formed of steel bars, with a breech of cast iron attached to it. The breech was entirely blown off the gun, and the bars torn asunder. It appeared to him absolutely necessary to have such a material as would not only resist the severe impulse which the discharge of the shot caused, but be perfectly solid in the mass. If they were made of parts, such as the staves of a cask, these opened, and the result was the fracture of the gun. The Stirling gun was a mixture of wrought with cast-iron, and it certainly carried one-fourth or one-fifth more of common pressure, but when applied to artillery under Colonel Dundas, after a few rounds the pieces were burst. The mode of casting these large guns is also defective. They were generally cast solid, and in the cooling the metal was left exceedingly porous in the centre, and when one began to bore out the gun, one found it was not of so close a texture inside as out. Now they took the precaution of having cores in the middle, through which they sent a current of cold water to cool the inside simultaneously.—Dr. ROBINSON: About a century ago they cast them hollow, and it was thought a great improvement to cast them solid.—Mr. FAIRBAIRN believed if they went about the work more carefully, they would arrive at a safer and better mode of casting than at present. If the mortars were made a foot longer, he believed, instead of sixty pounds, fifty pounds of powder would carry a shell of the same weight, and to a greater distance, and with greater accuracy. He thought, in the mortars, a great quantity of the metal was in the wrong place, in a great many cases. They had the same thickness of metal at the mouth as at the breech, whereas it might taper without any danger, the pressure being less at the mouth. He explained an ingenious ball, in which there was a spiral tube, so that the ball with an ordinary gun suited all the purposes of a rifle; but he did not know whether the experiment was successful or not. Till lately, guns of the ordinary calibre would stand 600 or 700 rounds before they were injured, but they always gave away at the vent. But they got into a plan of putting a tube into the vent, which made them stand 600 or 700 rounds more. Now-a-days the same guns would not stand 100 rounds; perhaps the reason was that the metal was not properly selected. He

believed the subject was now before the authorities at Woolwich of what caused the explosion at Sweaborg, —and he hoped it would lead to better material, or a better selection. The iron procured by hot blast is excellent for machinery purposes ; but he did not think it the best for artillery. With regard to the Turkish artillery, he was at Constantinople some years ago, and they are almost all made of a mixture of brass and tin. Mr. Mare, at Blackwall, is now constructing a gun three feet in diameter—the breech of cast iron and the tube of direction of wrought iron. Whether it would answer or not, he did not know.—Dr. ROBINSON: The bronze guns failed in a very remarkable manner. The ball rises on firing, is deflected on the gun, and if the gun is long it is again deflected, and deep holes are made in the barrel owing to the softness of the metal. Could not a thin lining of steel or wrought iron be inserted into the tube?—Mr. FAIRBAIRN thought it was very difficult to form any gun that differed in its parts. He would prefer to have a gun perfectly solid—of steel, if they pleased ; for he had seen excellent specimens of steel manufactures from Prussia in the Great Exhibition, and well calculated for making field artillery. The artillery of the present time was much larger than in former times, and allowance must be made for that. The Government was endeavoring at present to get charcoal iron from Nova Scotia, and there were large supplies of wood and iron in the Bay of Fundy.—Mr. LAWRIE proposed to have no vent at all, but to fire in the manner in which rocks are blasted, by means of galvanism. This would prevent wearing at the vent. He hoped artillery would be brought to perfection, for as weapons had improved, war had decreased in brutality ; and he hoped there would be a good stand up fight for it, in order that they might have a lasting peace.—A Member stated that some hydrostatic presses had been made of cast iron with a case of wrought iron, at Mr. Downie's works here, and had stood an immense pressure, but they had not as yet tried it on guns.—Mr. FAIRBAIRN asked if the gun made at Mr. Downie's had been cast in such a way as to cause an amalgamation of the cast and wrought iron? If that were the case, he had no doubt it would secure great strength. He had a doubt, however, that there was a difference of ductility which would cause separation. It had occurred to him that they might be cast under extreme hydrostatic pressure. They had cast them at Woolwich with 19 feet of iron on the gun, but he did not as yet know the result.—Mr. SYKES WARD thought a gun could not explode so readily if the powder did not impinge directly on the ball.

On certain Curious Motions observable on the Surfaces of Wine and other Alcoholic Liquors. By Mr. J. THOMSON.—The phenomena of capillary attraction in liquids are accounted for according to the generally received theory of Dr. Young, by the existence of forces equivalent to a tension of the surface of the liquid, uniform in all directions, and independent of the form of the surface. The tensile force is not the same in different liquids. Thus it is found to be much less in alcohol than in water. This fact affords an explanation of several very curious motions observable, under various circumstances, at the surface of alcoholic liquors. One part of these phenomena is that if, in the middle of the surface of a glass of water, a small quantity of alcohol, or strong spirituous liquor, be gently introduced, a rapid rushing of the surface is found to occur.

outwards from the place where the spirit is introduced. It is made more apparent if fine powder be dusted on the surface of the water. Another part of the phenomena is, that if the sides of the vessel be wet with water above the general level surface of the water, and if the spirit be introduced in sufficient quantity in the middle of the vessel, or if it be introduced near the side, the fluid is even seen to ascend the inside of the glass until it accumulates in some places to such an extent that its weight preponderates, and it falls down again. The manner in which Mr. Thomson explains these two parts of the phenomena is, that the more watery portions of the entire surface, having more tension than those which are more alcoholic, drag the latter briskly away, sometimes even so as to form a horizontal ring of liquid high up round the interior of the vessel, and thicker than that by which the interior of the vessel was wet. Then the tendency is for the various parts of this ring or line to run together to those parts which happen to be most watery, and so that there is no stable equilibrium, for the parts to which the various portions of the liquid aggregate themselves soon become too heavy to be sustained, and so they fall down. The same mode of explanation, when carried a step further, shows the reason of the curious motions commonly observed in the film of wine adhering to the inside of a wine-glass, when the glass having been partially filled with wine, has been shaken so as to wet the inside above the general level of the surface of the liquid; for, to explain these motions, it is only necessary further to bring under consideration that the thin film adhering to the inside of the glass must very quickly become more watery than the rest, on account of the evaporation of the alcohol contained in it being more rapid than the evaporation of the water. On this matter, Mr. Thomson exhibited to the Society a very decisive experiment. He showed that in a vial partly filled with wine, no motion, of the kind described, occurs as long as the vial is kept corked. On his removing the cork, however, and withdrawing, by a tube, the air saturated with vapor of the wine, so that it was replaced by fresh air capable of producing evaporation, a liquid film was instantly seen as a horizontal ring creeping up the interior of the vial, with thick-looking pendant streams descending from it like a fringe from a curtain. He gave another striking illustration by pouring water on a flat silver tray, previously carefully cleaned from any film which could hinder the water from thoroughly wetting the surface. The water was about one-tenth of an inch deep. Then, on a little alcohol being laid down in the middle of the tray, the water immediately rushed away from the middle, leaving a deep hollow there, which laid the tray bare of all liquid, except an exceedingly thin film. These and other experiments, which he made with fine lycopodium powder dusted on the surface of the water, into the middle of which he introduced alcohol gently from a fine tube, were very simple, and can easily be repeated. Certain curious return currents which he showed by means of the powder on the surface, he stated he had not yet been able fully to explain. He referred to very interesting phenomena previously observed by Mr. Varley, and described in the fiftieth volume of the Transactions of the Society of Arts, which he believed would prove to be explicable according to the principles he had now proposed.

On the Binocular Vision of Surfaces of different Colors. By Sir DAVID BREWSTER.—Prof. Dove had published an account of some beautiful experiments in connexion with this subject some years ago. M. Dove showed in his paper that when different colors at the same real distance are regarded by the eye they appear to be at different distances; this is also the case when a white surface is compared with a black. Now M. Dove argues if a white surface and a black one be stereoscopically combined, one of them must be seen through the other. Taking a figure for the left eye with a white ground, and a second figure of the same object on a black ground for the right eye, when these two figures are combined, a beautiful effect is observed: the figure starts into relief, and its sides appear to possess a shining metallic lustre. This is the case when the surface of each single object is quite dull and lustreless. On this experiment M. Dove founds a theory of lustre, supposing it to be produced by the action of light received from surfaces at different distances from the eye. An example of this is the effect observed on looking at varnished pictures: one portion of the light comes from the anterior surface of the varnish, and the other from its posterior surface, the action of both of these conspiring to produce the observed lustre. The metallic lustre of mica is also referred to by M. Dove as an example of the same kind. In his present communication, Sir David Brewster controverts the theory here laid down, and bases his objections on the following remarkable experiment:—where a white surface without definite boundary and a black surface of the same kind are regarded through the stereoscope no lustre is observed. Sir David therefore infers, that the lustre is due not to the rays from one surface passing through the other to the eye, but to the effort of the eyes to combine the two stereoscopic pictures.

Experimental Demonstration of the Polarity of Diamagnetic Bodies. By Prof. TYNDALL.—The author referred to the Bakerian Lecture of the present year as proving that a bar of bismuth freely suspended within a spiral of copper wire, excited by a current passing through that wire and acted upon by external magnets, could be attracted and repelled with the same certainty as, though with far less energy than, a bar of iron,—the sense of the deflection, which indicated the polarity of the diamagnetic bismuth bar, being always opposed to the deflection of the iron bar under the same circumstances. The experiments now described formed the complement, so to speak, of those described in the lecture referred to. In the latter case the bismuth bar is deflected by magnets, but as the action is mutual, it is to be expected that the magnets, if properly arranged, could be deflected by the diamagnetic bars. An experiment of this nature has already been made by Prof. Weber, of Göttingen, but the results obtained by this distinguished experimenter have not commanded general conviction; they have been denied and criticized by Matteucci and others. Prof Tyndall has to thank M. Weber for the plan of an instrument, constructed by M. Leyser, of Leipsic, which has enabled him to remove the last trace of doubt from this important question. The instrument consists essentially of two upright spirals of copper wire about eighteen inches long, fastened to a stout slab of wood, enclosed on all sides during the time of experiment, and so fixed into solid

masonry that the spirals were vertical. Above the spirals is a wooden wheel with a grooved circumference; below the spirals there was a similar wheel; an endless string passed tightly around both wheels, and to this string was attached two cylinders of the diamagnetic body to be examined. By turning the lower wheel by a suitable key, the cylinders may be moved up and down within the spirals. Two steel bar magnets are arranged to an astatic system, connected together by a rigid brass junction, and suspended so that both magnets are in the same horizontal plane. It is so arranged that these two magnets have the two spirals between them, and have their poles opposite to the centre of the spirals. When, therefore, a current is sent through the spirals, it exerts no more action on the magnets than the centre or neutral point of a magnet would do. Supposing the bars within the spirals to be also perfectly central, they also present their neutral points to the magnetic poles, and hence exert no action upon it. But if the key be turned so as to bring the two ends of the diamagnetic bars to act upon the suspended magnets, if the bars be polar, the magnitude and nature of their polarity will be indicated by the consequent deflection of the magnets. The index by which the deflection of the magnets is observed, is a ray of light deflected from a mirror attached to the magnets; and as the length of this ray may be varied at pleasure, the sensibility of the instrument may be indefinitely increased. When cylinders of bismuth are submitted to experiment, a very marked deflection is produced, indicating a polarity on the part of the bismuth to the polarity of iron. This is the result already obtained by M. Weber; but against it, it has been urged that the deflection is due to induced currents excited in the metallic cylinders during their motion within the spirals. To this objection Prof. Tyndall replied as follows:—first, the deflection produced was a *permanent* deflection, which could not be the case if it were due to the momentary currents of induction;—secondly, if due to induction, copper ought to show the effect far more energetically than bismuth, for its conducting power and, consequently, the facility with which such currents are produced, is at least fifty times greater than that of bismuth. But with cylinders of copper no sensible deflection was produced;—thirdly, two prisms of the heavy glass with which Mr. Faraday discovered the diamagnetic force and produced the rotation of the plane of polarization of a luminous ray were substituted for the metallic cylinders; and although the action was far less energetic, it was equally certain as in the case of bismuth, and indicated the same polarity. The formation of induced currents is wholly out of the question here, for the substance is an insulator. The experiments, therefore, remove the last remaining doubt from the position that diamagnetic bodies under magnetic excitement possess a polarity which is the reverse of that possessed by magnetic ones. Prof. Tyndall, in referring to his labors on this subject, and to the beautiful and costly apparatus by which these results have been obtained, observed that it was the funds placed at his disposal by the Council of the Royal Society, which enabled him to obtain these results; and this may be taken as an example of the manner in which the annual Government grant is applied to the promotion of scientific research and discovery.

On certain Anomalies presented by the Binary Star, 70 Ophiuchi. By Capt. W. S. JACOB.—This pair has been long known to astronomers as a binary system, but the exact orbit is yet in doubt, although nearly a whole revolution has been completed since it was first observed by Sir W. Herschel, in 1779. All the orbits that have been computed fail at certain points in representing the observed positions, and those which best represent the angles fail entirely as regards the distances. The most remarkable point is, that even in those orbits which agree best with observation, the errors in the angles assume a *periodical* form, retaining the same sign through a considerable space of time. An orbit has been computed with a period of 93 years, in which the errors are + from 1820 to 1823,—with one exception from 1823 to 1830, doubtful in 1830 to 1832, and from 1833 to 1842 all +, after which they continue for the most part —. This sort of error must depend upon some law; it *might* arise from a change in the law of gravitation, but may be accounted for more simply by supposing the existence of a third opaque body perturbing the other two. Such bodies have already been suggested to account for irregular motions of apparently single stars, such as Sirius and Procyon. The body in this case, if supposed to circulate as a planet round the smaller star, need not be very large, as the deviation from the ellipse does not exceed about $0''.1$. Assuming the small star to describe a secondary ellipse in which $a=0''.08$, $e=0''.15$ and $\omega=200^\circ$, and applying corresponding corrections to the computed positions, the average errors in the angles is reduced from $50'$ to $37'$, and in the distances measured subsequent to 1837, from $0''.14$ to $0''.11$, or by about $\frac{1}{4}$; while the maximum errors are also reduced in about the same proportion. There is, therefore, *prima facie* evidence for the existence of such a body, and it is desirable that the fact should be still further tested by careful observation. The subject possesses an additional interest at the present time, in reference to the opinion brought forward in the Essay "*Of the Plurality of Worlds*," on the *impossibility* of double stars having attendant planets.

On the Aurora Borealis. By Admiral Sir JOHN ROSS.—The communication I had the the honor of making to the British Association for the Advancement of Science at Belfast, on the interesting subject of the aurora borealis, was verbal, and, therefore, not entitled to a notice in the Association's valuable *Transactions* of that period; but, having subsequently repeated the experiments I then verbally mentioned, I can now confidently lay the account of them before the public, trusting that when taken into consideration, they will be found corroborative of the theory which I published in the year 1819, and which led to a controversy that shall be hereafter mentioned. It having occurred to me that, if my theory was true, namely, "that the phenomena of the aurora borealis were occasioned by the action of the sun, when below the pole, on the surrounding masses of colored ice, by its rays being reflected from the points of incidence to clouds above the pole which were before invisible," the phenomena might be artificially produced; to accomplish this, I placed a powerful lamp to represent the sun, having a lens, at the focal distance of which I placed a rectified terrestrial globe, on which bruised glass, of the various colors we have seen in Baffin's Bay, was placed, to

represent the colored icebergs we had seen in that locality, while the space between Greenland and Spitzbergen was left blank, to represent the sea. To represent the clouds above the pole, which were to receive the refracted rays, I applied a hot iron to a sponge; and, by giving the globe a regular diurnal motion, I produced the phenomena vulgarly called "The Merry Dancers," and every other appearance, exactly as seen in the natural sky, while it disappeared as the globe turned, as being the part representing the sea to the points of incidence. In corroboration of my theory, I have to remark that, during my last voyage to the Arctic Regions (1850-51), we never, among the numerous icebergs, saw any that were colored, but all were a yellowish white; and, during the following winter, the aurora was exactly the same color; and, when that part of the globe was covered with bruised glass of that color, the phenomena produced in my experiment was the same, as was, also, the Aurora Australis, in the Antarctic regions, where no colored icebergs were ever seen. The controversy to which I have alluded was between the celebrated Prof. Schumacher, of Altona, who supported my theory, and the no less distinguished M. Arago, who, having opposed it, sent M. G. Martens and another to Hammerfest on purpose to observe the aurora, and decide the question. I saw them at Stockholm on their return, when they told me their observations tended to confirm my theory; but their report being unfavorable to the expectations of M. Arago, it was never published; neither was the correspondence between the two Professors, owing to the lamented death of Prof. Schumacher. I regret that it is out of my power to exhibit the experiments I have described, owing to the peculiar manner in which the room must be darkened, even if I had the necessary apparatus with me; but it is an experiment so simple that it can easily be accomplished by any person interested in the beautiful phenomena of the aurora borealis.

On Hail Storms in India from 1851 to 1855. By Dr. BUIST, was read by Col. SYKES.

On the Establishment of a Magnetic, Meteorological, and Astronomical Observatory on the Mountain of Augustus Mulla, at 6200 feet, in Travancore. By ASTRONOMER BROWN.—Astronomer Brown, in a letter to Col. Sykes, dated 2d July, 1855, describes the successful establishment of an observatory on Augustus Mulla, at 6200 feet above the sea level, for the purpose of simultaneous record with the observatory at Trevandrum. The difficulties of access to the summit of the mountain were so great, from having to cut paths through dense jungles, infested by elephants and other wild animals,—from having to use ropes and mechanical aid in getting up the building materials, provisions, and the instruments,—and in the delays from the laborers running away from fright and the effects of cold,—that two years were consumed in the undertaking. The object of Astronomer Brown in making known his successful efforts in Europe, is to enable observers to put themselves into communication with him, in case they should desire to have any experimental researches made on so novel a position for an observatory.

On the Detection and Measurement of Atmospheric Electricity by the Photo-Barograph and Thermograph. By Mr. M. J. JOHNSON.—Photography has already rendered considerable aid to science, and some results

brought before the Section by Mr. Johnson, *Radcliffe Observer*, Oxford, furnish an example of this. On examining and comparing the registrations of the thermometer and barometer certain peculiarities presented themselves, which indicate a curious connexion between the course of these instruments and the state of the weather. The line which indicates this course is sometimes serrated, sometimes even and continuous; and these appearances correspond to certain determinate states of the weather. The most remarkable result is a sudden change of the height of the barometric column, which takes place simultaneously with the occurrence of a peal of thunder:—a contemporaneous effect was produced upon the thermometer. It is to be hoped that Mr. Johnson will continue his observations, so as to place the connexion, which he seems to have detected, beyond all doubt.

For the Journal of the Franklin Institute.

Particulars of the Steam Barge Franklin.

Hull built by Reed, of Boundbrook. Machinery by Reaney, Neafie & Co., Philadelphia, Pa. Intended service, freighting between Albany, Philadelphia, and Baltimore.

HULL.—

Length on deck,	.	.	.	105 feet.
Breadth of beam,	.	.	.	23 "
Depth of hold,	.	.	.	8 "
Length of engine space,	.	.	.	25 "
Centents of bunkers in tons of coal,	.	.	10.	
Mast,	.	.	1 for hoisting cargo.	

ENGINE—One—inverted cylinder—direct acting.—

Diameter of cylinder,	.	.	.	26 inches.
Length of stroke,	.	.	.	2 feet 1 "
Maximum pressure of steam in pounds,	.	60.	.	
Cut-off from commencement of stroke,	.	.	.	12½ "

BOILER—One—flue and return flue.—

Length of boiler,	.	.	.	16 feet 6 inches.
Breadth "	.	.	.	7 " 3 "
Height " exclusive of steam drum,	.	.	.	7 "
Cubic feet	.	60.	.	
Number of furnaces,	.	2.	.	
Breadth "	.	.	.	3 "
Length of grate bars,	.	.	.	5 "
Number of flues or tubes,	.	14.	.	
Internal diameter of flues or tubes,	.	.	.	6½ "
Length of flues or tubes,	.	.	.	11 "
Heating surface,	.	.	.	560 sq. feet.
Diameter of smoke pipe,	.	.	.	2 feet 4 "
Height "	.	.	.	24 "

SCREW PROPELLER.—

Diameter,	.	.	.	7 feet 6 inches.
Length of screw,	.	.	.	2 " 3 "
Pitch "	.	.	.	13 " 6 "
Number of blades,	.	.	4.	

W. J.

For the Journal of the Franklin Institute.

Particulars of a Tug Boat for Lake Ontario.

Hull built by Dobbin & Mainwaring, Oswego. Machinery by Reaney, Neafie & Co., Philadelphia, Pa. Intended service, towing on Oswego River and Lake Ontario.

HULL.—

Length on deck,	.	.	.	100 feet.
Breadth of beam,	.	.	.	18 "
Depth of hold,	.	.	.	9 "
Length of engine space,	.	.	.	32 "
Draft, estimated forward,	.	.	.	7 "
" aft,	.	.	.	8 "

ENGINES—Two—inverted cylinder—direct acting.—

Diameter of cylinder,	.	.	.	20 inches.
Length of stroke,	.	.	.	1 foot 8 "
Maximum pressure of steam in pounds,	60.			
Cut-off from commencement of stroke,	.			10 "

BOILER—One—flue and return flue.—

Length of boiler,	.	.	.	20 feet.
Breadth "	.	.	.	7 "
Height " exclusive of steam drum,	.	.	.	8 " 3 inches.
Number of furnaces,	2.			
Breadth "	.	.	.	2 " 9 "
Length of grate bars,	.	.	.	5 "

SCREW PROPELLER.—

Diameter of screw,	.	.	.	8 feet.
Length "	.	.	.	2 " 5 inches.
Pitch "	.	.	.	12 " 9 "
Number of blades,	4.			
Average revolutions per minute, estimated,	70.			

Remarks.—Cabins and engine room below deck.

The boiler is being constructed at Oswego, and is of sufficient size to furnish an abundance of steam when the engines are required to work whole stroke, in order to make way against the violent and sudden storms that occur on the lakes.

W. J.

*Failure of the Nasmyth Gun.**

The alleged failure of the Nasmyth Gun has called the attention of scientific men to the changes which iron undergoes by use, and to the causes which accelerate its passage from the fibrous to the crystalline state. Dr. Noad, during a visit to the Welsh iron mines, has tried some experiments, and communicated the results obtained to the public,—results of deep interest, considering how extensively iron is now used for bridges, cables, and supports. Dr. Noad says:—"The tendency of iron to pass from the fibrous or tough to the crystalline or brittle condition is promoted by various causes; every thing, in fact, which occasions a vibration among its particles has this tendency."—He then describes his experiments, which prove that the metal may be made to pass from one

* From the London Athenæum, September, 1855.

state to the other :—"Seeing a large quantity of iron chain lying about, and learning that, though scarcely worn, it had been laid aside in consequence of the breaking of some of the links, I examined several from different parts of the chain. I found that a single smart blow with a hammer was sufficient to snap the metal, the fracture of which was crystalline, and its brittleness such that it could, without difficulty, be broken into small pieces under the hammer. I now heated strongly in a forge some of the broken links, and allowed them to cool very slowly underneath a bed of fine sand. After the lapse of twenty-four hours they were examined; the metal was found to have recovered its tenacity, it could no longer be broken to pieces under the hammer; and when at length, after repeated heavy blows, it did partially yield, the texture of the metal was found to be perfectly fibrous—every trace of a crystalline structure had disappeared."—Dr. Noad thinks that the iron of the Nasmyth Gun has been crystallized by continuous hammering; and he suggests that its fibrous condition may be restored by annealing. But this is scarcely the most interesting question raised. How about the iron bridges? Are they passing into that crystalline condition in which they will be as strong as glass—and no stronger? How, again, about our chain cables? Are our leviathans of the deep floating in a fanciful security, trusting to iron ropes that will snap as a child's thread in the day of storms?

*History and Properties of Aluminium.**

A fine bar of aluminium is now on view at the Polytechnic Institution, where Mr. Pepper explains its history and properties. This metal was discovered by Sir H. Davy in 1808. Oersted endeavored to exhibit the metal in a detached form by the employment of chloride of aluminium, and about thirty years ago Wöhler succeeded in obtaining a few grains of it. It has been reserved, however, for M. St. Clair Deville to produce (in the private laboratory of the Emperor of France) a whole bar of aluminium, which has been presented to Mr. Pepper by the Emperor. After giving a brief history of the metal, the non-success of experiments for obtaining it, and the "sodium" and "voltaic battery" processes, Mr. Pepper describes its nature and properties. "Aluminium" is classed by M. Deville as an "unalterable" metal, intermediate between the precious and the more common metals. Mr. Fownes includes it in the same category as glucinum, yttrium, cerium, lanthanum, didymium, zirconium, and thorium—all of them "metals of the earth proper." The specific gravity of aluminium is 2.56 (or 2.60 according to Mr. Fownes, water being taken as unity). This is about one-eighth of the gravity of platinum, and one-third that of iron, platinum being 20.98; gold, 19.26; mercury, 13.57; silver, 10.47; iron, 7.79; zinc, 6.5; and titanium (next above aluminium), 5.30. The equivalent of aluminium is 13.69. The metal is beautifully white, with a slight blueish tinge, and reflects light clearly. It is malleable and ductile, almost without limit; when passed through the fingers it exhales a slight odor of iron. It is a perfect conductor of electricity,—the best known among the metals,

* From the *Lond. Athenæum*, August, 1855.

—and is negative to zinc. It melts at a rather higher temperature than zinc, and is excessively fusible. The chemical properties of aluminium are invaluable. It resists oxygen,—water has no action upon it at any temperature,—and even sulphuretted hydrogen—that great defacer of the brightness of metals in large towns—exercises no destructive influence upon it. It is now, moreover, ascertained that the metal does not decompose water. Thus aluminium bids fair to become one of the most useful and serviceable of the metals, and from it have already been manufactured some medals and watch-wheels of exquisite workmanship.—Under Mr. Pepper's active management, the Polytechnic is perpetually adding to its attractions. Some of his experiments with Thames water are particularly interesting just now.

*Notice of the Launch of the Cunard Steamer "Persia."**

On the 3d of July, the steamship *Persia*, the first iron paddle-wheel liner, built by the orders of the Messrs. Burns, of Glasgow, for the Cunard, or British and North American Steam Company, was launched from the building-yard of Messrs. Robert Napier and Sons, at Govan. Messrs. Napier are the builders both of the hull and the engines. The *Persia* is the largest steamer both in capacity of hull and steam power which has yet been built. The *Persia* far exceeds in length, strength, tonnage, and steam power the *Great Britain* or the *Himalaya*, and exceeds also by no less than 1200 tons the internal capacity of the largest of the present Cunard liners. Her chief proportions are these:—Length from figure-head to taffrail, 390 feet; length in the water, 360 feet; breadth of the hull, 45 feet; breadth over all, 71 feet; depth, 32 feet; burden 3600 tons. According to the strict government rule of admeasurement, her power is equal to that of 900 horses; according to the plan laid down in Earl Hardwicke's bill, her power is equal to that of 1200 horses. The *Persia* has seven water-tight compartments. The goods are to be stowed in two of these divisions, each about 90 feet long, by 16 in breadth, and 20 feet in height. These goods stores, or rather tanks, are placed in the centre line of the ship, with the coal cellars or bunkers on each side of them. At the same time the vessel is so constructed as to have a double bottom under these goods chambers, so that if the outer were beat in or injured, the inner would, in all likelihood, protect them dry and intact. She has separate sleeping accommodations for nearly 300 passengers, disposed along what may be called the main deck, lying immediately above the goods and coal stores. There are in the forward part of the ship about 210 berths for the sailing crew, firemen, and stokers.

Simple mode of Cutting Stone.†

Among the French machinery will be found a very ingenious and simple mode of cutting stone, exhibited by a man named Chevaliere. He causes a wire to run at a high velocity over the surface which he wishes to bisect, and by dropping on it a mixture of sand and water the oper-

* From the Lond. Civ. Eng. and Arch. Jour., August, 1855.

† From the London Mining Journal, No. 1047.

ation is rapidly completed. The hardest granites yield so quickly to this process, that the inventor can with one-horse power separate it at the rate of a square foot per hour, the wire running at the rate of 40 ft. per second. Using the ordinary saw, the same amount of work would require three-horse power, and would expend 15 frs. worth of material, instead of 1 fr., which is all that the wire costs.

Remarks on the Smoke Question. By C. W. WILLIAMS.*

To the Editor of the *Mechanics' Magazine*.

SIR.—In your number of this day, page 612, under the head of “The Smoke Question,” you have given an abstract of the “Conclusions deduced from the Evidence obtained by the General Board of Health,” and now printed by order of Parliament. As these “conclusions” contain not only many useful remarks, but also many inaccuracies and errors, by which the public may be led astray, I propose submitting, through your columns, some observations on each, and by which they will become more intelligible, and at the same time remove those misapprehensions which have, no doubt inadvertently, been introduced.

Conclusion 1. “That the emission of smoke is the effect, and may be taken as the proof of *imperfect combustion*, and is therefore always attended with waste of fuel.”

This conclusion is too general to be practically useful. It leaves the main question untouched, and the main issue undecided, namely: What is imperfect combustion, and what is the combustible that is *imperfectly consumed*? Until these are determined, the means of counteracting this imperfection must be equally undetermined. Now, imperfect combustion has not reference to the coal employed, but to the gaseous portion of it, generated in the furnace, and arises from two causes; first, the allowing a portion of the carbon of the gas to pass away, unburnt, by allowing it to be reduced in temperature below that required for its ignition, and before it had obtained atomic contact with the oxygen of the air; secondly, from another portion of the carbon being allowed to pass away, unconsumed, in the form of invisible carbonic oxide. The remedy in both cases lies in bringing the air, either to the carbon or the oxide, not in a body, but in such a *divided form* as to enable it instantaneously to effect the required mixture, and atomic contact, which is the *sine qua non* of subsequent combustion.

Conclusion 2. “That the fuel wasted is not only the visible smoke, which is *unburnt carbon*, but generally a far larger portion in the form of gas, both common coal gas and that called carbonic oxide, which is only *half-burnt carbon*, and which therefore has not produced the heat which it would have generated if it had been perfectly consumed.

This is incorrect in several respects. Visible smoke is not “*unburnt carbon*.” Smoke is a compound of large cloud-like volumes of carbonic acid, nitrogen, and steam (the latter from the combustion of the hydrogen of the gas). With these three are mixed more or less of unburnt

* From the *Mechanics' Magazine*, July, 1855.

carbon, but relatively in such a small proportion that although it gives the cloudy volumes their blackened color, is nevertheless, comparatively, so insignificant in weight or value, as to be, commercially, unworthy of notice as a combustible, were it possible, which it is not, to effect its combustion, diffused as it necessarily must be in those cloudy masses.

Again—carbonic oxide is not “half-burnt carbon.” There is, in fact, no such thing as half-burnt carbon. An atom of carbon must be either burnt or unburnt. Carbonic oxide is a distinct, well-defined gas. It is formed in the furnace, not from the coal, but from the coke portion of the coal, when in an incandescent state. Carbonic acid, formed from one portion of such incandescent, or red-hot fuel passing up through the portion above it, takes up an additional equivalent of carbon. Thus, one volume of carbonic acid is formed into two volumes of carbonic oxide. Its combustion, when the air is admitted, is easily distinguished in the furnace by its semi-transparent bluish color, and may be perceived in the fire-box of the locomotive when the door is opened.

Conclusion 3. “That the chief impediment to the prevention of smoke in manufactories is the *insufficient boiler surface* in proportion to the steam required; a deficiency which causes waste in two ways; first, because much of the heat produced escapes up the chimney uselessly, and next, because this deficiency has to be made up by *over-firing*, whence imperfect combustion and consequent waste of fuel.”

This conclusion is erroneous and misleading. The prevention of smoke has no relation to the “insufficient boiler surface.” This is shown by the fact that smoke is formed in the same way and to the same extent where there is neither boiler nor boiler surface; as in many furnaces used in manufactories; for instance, in the charcoal heating furnaces of the sugar refiners, or those used for heating the iron plates of boiler makers and iron ship builders. The generation of the heat in the furnace and the generation of steam in the boiler are distinct processes, and the confounding the one with the other is a serious mistake, and tends to lead boiler makers and engineers astray. What is called “*over-firing*,” is but effecting a more rapid combustion, as when we stir the fuel in a house grate. If the fuel be more rapidly consumed in the furnace, there must necessarily be more gas generated in equal time, and, of course, more air is required for such increased quantity of gas. It is the overlooking of the necessity for this increased quantity of air which leads engineers into this error.

Conclusion 4. “The employers of furnaces labor under great difficulty as to the best and most economical use of fuel, because ordinary makers of furnaces seem to be guided in their construction by little better than empirical rules, instead of acting upon well established scientific principles, or the results of accurate experiments.”

This conclusion is too well founded to require any comment.

Conclusion 5. “That notwithstanding this great difficulty, many persons have succeeded in entirely preventing the escape [formation] of visible smoke, except while first lighting their furnaces, and many others have reduced the time during which smoke is emitted to a fraction of its former amount.”

This is also unquestionably true.

Conclusion 6. "That experience has fully proved that there is no truth in the common allegation, that if smoke be prevented, there must be increased difficulty in getting up and maintaining steam."

This is also true, provided the combustion in the furnace and the prevention of the formation of smoke be properly effected by the introduction of the *required quantity* of air, in the *proper manner*. If, however, the air be injudiciously introduced, though smoke may be prevented, nevertheless there may be "increased difficulty in getting and maintaining steam."

Liverpool, June 30, 1855.

(To be Continued.)

*Statistics of Copper and Zinc.**

A return obtained by Mr. M. Williams, M. P., shows that the total quantity of copper imported into the United Kingdom in 1854, amounted to 50,940 tons of ore, 6351 tons of regulus, 1597 tons of unwrought copper, 1621 tons of partly-wrought copper, 710 tons of plates and coin, and 638 tons of manufactures. The total quantity of British copper exported in 1854, amounted to 13,678 tons (exclusive of ore). The total quantity of British copper exported from the port of London in 1854, amounted to 5434 tons, and from Liverpool, 5920 tons. The quantity of zinc or spelter imported into the kingdom in 1854, was 19,588 tons, and 336 tons of oxide of zinc, while the quantity of British and foreign zinc or spelter exported, was respectively 3030 and 5322 tons.

Mineral Statistics of Great Britain.†

From 2397 collieries enumerated in the United Kingdom, 64,661,401 tons were raised, worth nearly 15,000,000*l.*, or nearly 9,000,000 tons above the quantity stated in the highest figures previously quoted,—those of Mr. T. Y. Hall. Of tin, the annual produce is stated at 5763 tons, which, at from 112*l.* to 118*l.* a ton, would be worth nearly 700,000*l.* Of copper, 13,000 tons were produced in 1854, worth about 1,229,000*l.*; of lead 64,000 tons; and of silver, 700,000 ounces. Of pig-iron, the produce was 3,069,838 tons, valued at 9,500,000*l.* Mr. Hunt has ascertained that more than 300,000 persons are employed in mining operations in Great Britain,—nearly one-third of them being males under twenty, while nearly 9000 are females, and of these the larger proportion under twenty years of age.

Aberdeen Railway Accident.‡

We copy the following in the hopes that it may be found useful to our Courts, and Railroad officials.

Ed. Journ. F. I.

Wm. Joss, station-master at the Cove station, and Andrew Symon, a porter, who were tried at the Circuit court of Justiciary at Aberdeen, for the late accident on the above line, in consequence of which Ensign Dobie had both his legs fractured, and other passengers were injured,

* From the Lond. Builder, No. 649.

† From the Lond. Athenæum, September, 1855.

‡ From Herapath's Journal, October 6, 1855.

were sentenced to three months imprisonment by Lords Cowan and Handyside, accompanied with some severe observation, notwithstanding the jury strongly recommended them to mercy on account of previous good conduct. Severity, we are convinced, is the only way to cure negligence, and is the best of kindness to railway servants.

For the Journal of the Franklin Institute.

Particulars of the Steamer America.

Hull built by Wm. H. Webb, New York. Machinery by Novelty Iron Works, New York. Intended service, Pacific Ocean.

HULL.—

Length on deck, from fore part of stem to after part of stern post above spar deck, . . .	170 feet.	
Breadth of beam at midship section, . . .	27 "	8 inches.
" " to spar deck, . . .	12 "	
Draft of water at load line, . . .	8 "	6 "
" " below pressure and revolution, . . .	8 "	6 "
Tonnage, (custom house,) . . .	650.	
Area of immersed midship section at this draft, . . .	205 sq. feet.	
Contents of bunkers in tons of coal, . . .	225.	
Masts and rig, . . .	Brigantine.	

ENGINES.—Oscillating.

Diameter of cylinders, . . .	45 inches.
Length of stroke, . . .	5 feet.
Maximum pressure of steam in pounds, . . .	25.
Cut-off at . . .	$\frac{1}{2}$.
Maximum revolutions per minute, . . .	20.
Weight of engines, . . .	75 tons.

BOILERS.—Two—return flued.

Length of boilers, . . .	21 feet.	
Breadth " . . .	9 "	6 inches.
Height " exclusive of steam chimney, . . .	9 "	
Weight " without water, . . .	65,200 pounds.	
Number of furnaces in each boiler, . . .	3.	
Breadth of furnaces, . . .	{ 2 " 4 $\frac{1}{2}$ "	
	{ 2 " 11 "	
	6 "	
Length of grate bars, . . .		
Number of flues, . . .	15.	
Internal diameter of flues or tubes, . . .	{ 9 of 15 $\frac{1}{2}$ "	
	{ 2 " 14 $\frac{1}{2}$ "	
	{ 4 " 10 "	
Length of flues, { 5 of 15 $\frac{1}{2}$ in. . .	15 "	3
{ the remainder, . . .	10 "	
Heating surface, (fire and flues) in each boiler, . . .	940 sq. feet.	
Diameter of smoke pipe, . . .		50 inches.
Height, " . . .	28 "	
Description of coal, . . .	Bituminous.	
Combustion, . . .	Natural draft.	
Consumption of coal per hour, . . .	15 pounds.	

PADDLE WHEELS.—

Diameter, . . .	22 feet.
Length of blades, . . .	8 "
Depth, " . . .	20 inches.
Number, " . . .	20

Remarks.—Floor timbers at throat, moulded 12 ins.; sided, 14 ins. Distance of frames apart at centres, 28 ins. Frame strapped with diagonal and double laid iron straps 4 by $\frac{1}{2}$ ins.

C. H. H.

*Castor Oil as a Mechanical Lubricant.** By ALEXANDER CHAPLIN.

In these times, when workshop economies are claiming so large a share of attention, it may be of importance to the readers of the *Practical Mechanics' Journal* to know that there is considerable advantage and economy in the use of pure castor oil as a lubricating material for machinery. For this purpose, I have found it to go at least twice as far as any other oil. The causes of this gain are, that this oil does not run out of the bearing, whilst it does not clog from viscosity, and it is entirely free from acidity of every kind. Actual experience has told me, that bearings which formerly required oiling twice or thrice a day, are kept in perfect order by one daily application of fine castor oil. As to cost, the present market price leaves, under the circumstances, a saving of 50 per cent.

Glasgow, September, 1855.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, December 20, 1855.

John Agnew, Vice President, in the chair.

John F. Frazer, Treasurer.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

A letter was read from the Royal Imperial Geological Society of Vienna, Austria.

Donations to the Library were received from The Commissioners of Patents, Great Seal Patent Office; The Royal Astronomical Society; The Institute of Actuaries, and the Society of Arts, &c., London; The Royal Imperial Geological Society of Vienna, Austria; Lieut. J. M. Gillis, U. S. Navy; The University of Michigan, The Baltimore and Ohio Railroad Co., The West Jersey Collegiate School, and from Prof. J. F. Frazer, Mrs. W. H. Keating, Dr. J. A. Meigs, Philip Price, and George M. Conarroe, Philadelphia.

Donations to the Cabinets of Models and of Minerals from Josephus Echols, Columbus, Georgia; and Dr. L. Turnbull, Dr. J. T. Sharpless, Wm. H. Dennison, and E. G. Pomeroy of Philadelphia.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer read his statement of the receipts and payments for the month of November.

The Board of Managers and Standing Committees reported their minutes.

Resignations of membership in the Institute by 12 gentlemen, were read and accepted.

The candidates for membership in the Institute, (17,) were proposed, and the candidates proposed at the last meeting, (11,) were duly elected.

The Corresponding Secretary was instructed to send to the Commissioners of Patents, Great Seal Patent Office, London, a special acknowledgment of the valuable donation received from them.

Nominations were made for officers, managers, and auditors of the Institute for the ensuing year.

From the Lon. Prac. Mech. Journal, October, 1855.

On motion it was

Resolved, That the polls for receiving the votes of the members of the Institute for officers, managers, and auditors for the ensuing year at the annual election, to be held on Thursday, January 17th, 1856, shall be opened at 3½ and close at 8 o'clock, P. M., and that seven members be appointed, by the President, a committee to receive the votes and report the result thereof.

Mr. John Tremper exhibited and explained his improvement in the Governor for Steam Engines, which is now before the Committee on Science and the Arts, for notice of his claim, see report of Patents, top of page 13.

Mr. Howson exhibited several specimens of imitations of wood carvings manufactured by Israel Amies, Esq., of this city. Veneers of plain or fancy woods are prepared by a simple and unexpensive process, and are subjected to the pressure of heated dies on which are engraved the devices required. When removed from the dies, the cavities at the back of the embossed veneers are filled up with a suitable cement, when they are ready for gluing to any articles of furniture; this is accomplished with but little more difficulty than is experienced by cabinet makers in gluing ordinary flat veneers.

In answer to the remarks of the chairman, as to the well known process of embossing wood, Mr. H. observed that in manufactories at Birmingham and Sheffield, fancy devices for snuff boxes and other purposes were embossed on solid wood blocks by softening the same, afterward inclosing them in metal boxes and subjecting them to the pressure of dies.

Devices embossed in this manner, were apt, however, to become partially obliterated, and lose the sharpness of the impression when the blocks become wet. By Mr. Amies's process no exposure to dampness or heat can alter or deteriorate the relief.

A patent for the employment of embossed veneers in the construction of furniture and for other ornamental purposes has been granted to Mr. Amies, who has taken the necessary steps for securing his invention in several European States.

Mr. Howson, also, exhibited a new musical instrument, termed by the inventor, Mr. Zimmerman, an orchestrina. In shape, this instrument is similar to the ordinary concertina, having a box at each end with metal reeds and suitable keys, and bellows between the two boxes. By a simple arrangement of stops within reach of the thumb of the operator, six distinct tones are produced from one key.

Another improvement is the addition of trumpet-mouthed tubes to the boxes in such a manner, that all the sound produced by the action of the bellows on the reeds must pass through the tubes, producing tones of much greater harmony and volume than those which proceed from the ordinary accordeons and concertinas.

In answer to the inquiries of Professor Frazer, Mr. Howson remarked, that the inventor, in preparing his application for a patent, did not claim, exclusively, the producing of various tones from one key, but merely his simple contrivance for effecting that purpose.

Mr. Zimmerman, the inventor, entertained the meeting with several beautiful airs, illustrating the varied power and compass of his instrument.

JOURNAL
OF
THE FRANKLIN INSTITUTE
OF THE STATE OF PENNSYLVANIA
FOR THE
PROMOTION OF THE MECHANIC ARTS.

FEBRUARY, 1856.

CIVIL ENGINEERING.

Extract from the Report on the Texas Western Railroad Company.

In the winter of 1852 the Legislature of the State of Texas incorporated this Company, and invested it with the right to locate, construct, own, and maintain a Railroad from the Eastern boundary of Texas to El Paso, on the Rio Grande—a distance of about 800 miles. With the charter, they also granted a donation of eight sections of land of 640 acres each, for every mile of road actually completed by them ready for use; which grant was increased by the next Legislature, January 30, 1854, to sixteen sections, or 10,240 acres of land for every mile of road so constructed—lands to be made over to the company as soon as twenty-five miles of the road should be completed, and afterwards on the completion of every five miles of road, until the whole road should be finished. The unsold lands, comprising about three-fourths of the whole, along the entire line of the road through Texas, and two degrees, or about 140 miles in width, are exempt from entry, and reserved for the construction of the road; which will enable the company to make very choice and valuable selections; and with the road built up to them, must be worth on the average, including town sites, &c., at least five dollars per acre.

Knowing that the line of this road must evidently be the track of the great Pacific Railroad, the company, at great expense, employed Col. A. B. Gray, late U. S. Commissioner of the Mexican Boundary Commission, with an ample corps of Engineers, to survey this route from Texas to the Pacific. His able and very valuable report is now published, and is commended to the careful consideration of the public. Extracts from

it will be found hereafter. By this survey the whole route is shown to be perfectly easy and practicable, with favorable grades and curves—equal in the average, to those of our Western Railroads; free from inclined planes and tunnels—passing through a country surpassingly rich in soil and minerals—abounding in wood and water, coal, iron, and stone, and a forest growth suitable for all building purposes, far more than three-fourths of the whole distance—south of the snow and mountains, with a most salubrious climate, and with no deserts intervening on this route between the Mississippi River and the Gulf of California, in the proper direction for San Francisco. The cost of the road, and equipment through the State of Texas, (783 miles,) from navigable waters of the Mississippi near Shreveport, Louisiana, to the Rio Grande, near El Paso, is \$19,688,366. Average cost per mile, \$25,114.

Total cost of Railway (1621 miles) from navigable waters of the Mississippi—eastern boundary of Texas—to the Harbors of the Pacific, \$44,470,674. Value of lands donated under Texas Western Railroad Charter, granted February 16, 1852, (8 sections to the mile, and estimating only 8 under Act of 30th January, 1854), 10,240 acres for every mile of road built, as per estimate in the first Division, \$44,789,760.

The estimated net profits, when completed, is shown to exceed those of any other Railroad on this continent.

Major Blanche, the chief engineer of the company, with a corps of able assistants, has made an accurate survey of the first hundred and fifty-five miles of the road, to a point beyond the Trinity, and found it to be most favorable, estimating the average cost, per mile, complete and ready for use, at \$22,000, and with no grade exceeding thirty-six feet per mile.

On the 4th of July last, we commenced building the road on this route, at Caddo Lake, an excellent steamboat landing on the navigable waters of Red River. We are still progressing with the work, but not with as large a force as we would have had, could we have enjoyed the usual facilities of navigation on Red River, which have in a great measure been cut off by the extreme and unprecedented drought in the South and West for the last year.

Recently, one hundred additional miles of the road have been let to a company of responsible and efficient Contractors—the work to be commenced by the first of November next (1855); to be prosecuted vigorously, with a large force, until completed.

The first section of fifteen miles, from our steamboat landing, brings us to Marshall, the capital of the rich and populous county of Harrison, in Texas, over which a vast amount of cotton would be transported. It is the estimate of our engineer, that these fifteen miles of road will yield a net profit scarcely exceeded by any road in the United States; and, when extended through the rich and populous counties westward, this rate of profit will be greatly augmented. For several hundred miles from the commencement of our road, the counties of Texas through which it runs, are now more densely populated than the average counties of the Southern States; and affording, even at the present time, sufficient business to render a road profitable. The emigration to these counties is now immense, growing in part out of the location of this road, as also

arising from the wonderful fertility of the soil, and remarkable salubrity of the climate.

It is now universally conceded that this will be the great trunk road, to which all other roads in the South and West will seek to unite—connecting on the eastern line of Texas, with the Vicksburg, Shreveport, and Texas road, the whole of which, from the boundary of Texas, twenty miles east of Marshall, to Vicksburg, on the Mississippi River, is now under contract. The State of Louisiana takes a deep interest in this road, and has lately subscribed 2,000,000 of dollars for the speedy prosecution and early completion of the work.

By this connexion, we reach the Mississippi River at an early day, and at Vicksburg unite with the whole system of Southern railroads, of some six thousand miles in extent. By these we reach the more northerly roads, bringing us to all the cities of the interior, the Gulf of Mexico, and the sea-board of the Atlantic.

The New Orleans and Opelousas Railroad Company, anxious to connect with us as soon as practicable, are now extending their road through Louisiana and Eastern Texas to Marshall. This road will be about 326 miles in length, 120 of which is now in operation, and 47 miles more nearly ready for the superstructure; by which branch we have direct and easy communication from the city of New Orleans. The Galveston, Houston, and Henderson Railroad will also intersect our road at Marshall, about fifty miles of it being now in operation, and the means provided for the completion of the balance—about 400 miles. Other roads, extending in a northerly direction from the Gulf in Texas, will form connexion with us at different points along the line, as will best suit their interests. The Memphis and Little Rock Railroad and the Cairo and Fulton Railroad, will connect with us at Marshall. The former of these is now under contract for the entire length, and the latter, it is understood, will be put under contract the whole distance (310 miles) to Fulton early next season. Both of these roads have grants of six sections of land for every mile of road. When the latter road is completed, Marshall, in Texas, will be brought within 750 miles, or 30 hours of Cincinnati, and within 550 miles, or 22 hours, of St. Louis; thus saving in time 14 or 15 days, and in distance 1200 to 1400 miles. Marshall will become a great commercial centre—a depot for an immense trade. In extending our branch to Fulton, we cross Caddo Lake, which connects us with the navigable waters of Red River, and opens a water communication with the whole valley of the Mississippi.

*Description of a new Instrument for Geologists and Miners, called a
"Metra."**

Whilst popular treatises bring each of the advances of science within the circle of "common things," efforts are making "*pari passu*" to simplify the means or the instruments by which observations may be taken. Many scientific instruments are already domesticated in the halls of England, and we may fairly expect that as each merchant captain records his observations for Lieutenant Maury's behoof, so travelers will

* From the Practical Mechanic's Journal, December, 1855.

go provided with measures of the powers of the earth, and of the air, for the benefit of some geological or other compiler.

A new instrument attracted much interest at the late meeting of the British Association, as offering to the traveler and engineer the means of taking most of those measurements which it is useful to record. Without sacrificing the strength necessary for constant use, or interfering with the accuracy of each portion, this instrument contains, in a brass case, three inches square, and little more than one inch thick, eleven different instruments. The traveler in distant lands can ascertain by its means the temperature, the force of the wind, the latitude, the position of the rocks, or survey and map his route. The geologist can determine and draw the direction and amount of dip of the rocks, the angles of cleavage and crystallization, the temperature of springs, or examine, by a plate of tourmaline, the bottoms of pools or shallow depths along coast lines,

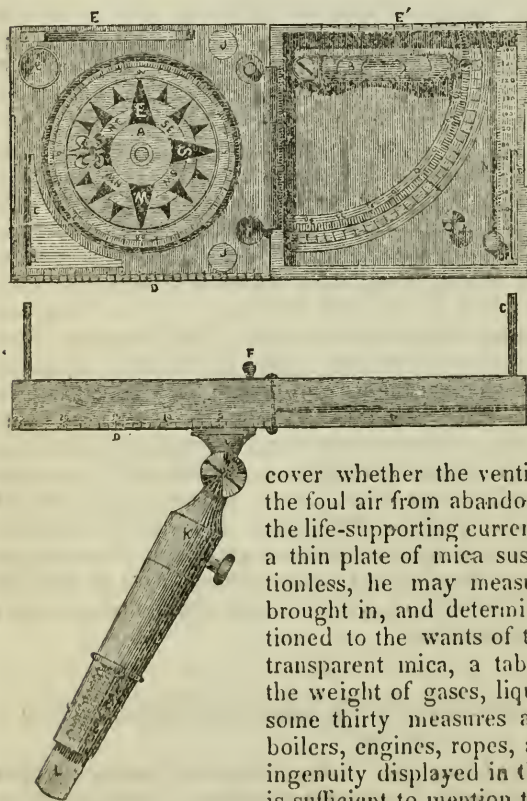
otherwise invisible to the eye. The miner, for whom chiefly this little instrument is intended, can moreover survey and level the roof or floor of his workings, and requires only a pencil to map them upon paper. It contains also a magnifying lens, and a measure of the wires in a Davy lamp. The miner can ascertain the temperature of the air under ground, and discover

whether the ventilation is deficient, or if the foul air from abandoned workings leaks, into the life-supporting current. By the anemometer, a thin plate of mica suspended so as to be frictionless, he may measure the quantity of air brought in, and determine whether it is proportioned to the wants of the mine. Beneath the transparent mica, a table of constants exhibits the weight of gases, liquids, and solids, besides some thirty measures and formulæ for steam boilers, engines, ropes, and air. To exhibit the ingenuity displayed in this pocket instrument, it is sufficient to mention that it contains a clinometer, goniometer, level, double compass, plotting

scales of various kinds, and an anemometer. Under the name of "Metra" it gained a medal at the last exhibition of the Society of Arts.

It was contrived by Mr. Herbert Mackworth, one of her Majesty's inspectors of mines, for his own use in underground observations.

The accompanying figs. 1 and 2, represent the plan and side view of the



metra when open and ready for use. *A* is the double compass, and *B* the level. The arc is graduated in degrees and in inches fall per yard. *C* the sights, *D* the scales, *E* the goniometer arm, and *E'* the goniometer scale; *F* the plummet, *G* the lens, with a telescopic slide to measure the wire gauze; *H* the tourmaline, *J* the pivots on which the instrument stands, *K* are the two joints of the brass leg, by which the horizontality of the instrument can be obtained; *L* is a flat chisel point for entering joints of rock or masonry. This end unscrews, exposing a wood screw, *M*, by which the leg can be secured to a tree or a stand. *N* is the thermometer, *O* the screw which secures the top and bottom of the instrument together. Beneath the bottom, *P*, are placed the anemometer and the table of constants. The adjustments of the metra possess several novelties, with the view of shortening the operator's work. On this head we may allude to the plan of laying down the surveys on paper, without the aid of anything but a pencil, by first adjusting the north and south line of the plan by the compass, and fastening the paper down by weights. The compass then serves as a protractor, and by the engraved scales the distances are measured off. This method saves calculation and ruling parallel lines, and obviates some instrumental errors. The inventor states, that any dial or theodolite can be fixed to a scale, and used in a similar way as a protractor. The instrument is made by Mr. J. D. King, of Bristol, as well as a simpler form in box-wood, adapted for geologists.

*Comparative Results Obtained from the Screw and Paddle-Wheel in the Steamships "*Himalaya*" and "*Atrato*."**

The performance of these vessels affords a valuable opportunity for comparing the relative efficiency of the screw and paddle-wheel as applied to large ocean steamers; and particularly so, as they are, with only one or two exceptions, the largest afloat, and approximate so closely to each other in size and speed. They are built of the same material, *iron*; commenced running in the same year and from the same port; and may be considered to offer, in all respects, a fair exposition of their respective systems of steam propulsion.

In one vessel, we have the direct-acting screw-engine of Messrs. Penn, simple, compact, and light; its screw propeller little more than 10 tons in weight, and yet fully equal to its task of transmitting the power of the engines for the propulsion of this huge ship.

On the other hand, there is the ponderous beam or side-lever engine, necessarily complex and bulky, with the feathering paddle-wheels, each probably weighing about 70 tons, and requiring enormous paddle-boxes and framing to support them.

In one case there are four screw-shaft bearings to look after and keep in order; in the other, 128 working parts requiring care and attention.

The first cost of the *Himalaya*'s screw would be under £400; the feathering wheels of the *Atrato* would probably cost not less than £5000.

We will now give, in a tabular form, some dimensions of the vessels and their machinery, speed at measured mile, &c.:—

* From the Lond. Artizan, December, 1855.

VESSELS.		SCREW. <i>Himalaya.</i>	PADDLE. <i>Atrato.</i>
Built by	{	Mare, of Blackwall. Penn & Co. May 24, 1853.	Caird, of Greenock. Caird. April 26, 1853.
Engines, ...		340 ft. 6 in.	318 ft.
Launched, ...		336 ft. 6 in.	315 ft.
Length between perpendiculars, ...		46 ft. 1 in.	42 ft.
Ditto at load line, ...		34 ft. 6 in.	36 ft.
Breadth, extreme, ...		3550 tons.	2721 tons.
Depth from underside spar-deck to top keel, ...		2327 8-100 t's.	2600 75-100 t's.
Tonnage, B. M., ...		1100 tons.	1440 tons.
Tonnage, register, ...			
Stowage for coal, ...			
MACHINERY.			
Nominal H. P. of engines, ...		700.	900.
Diameter of cylinders (effective), ...		77 $\frac{3}{4}$ in.	96 in.
Stroke of pistons, ...		3 ft. 6 in.	9 ft.
Cubic contents of both cylinders for one double stroke, ...		462 cubic ft.	1807 cub. ft.
Diameter of screw and of paddle-wheels, ...		18 ft.	36 ft. 6 in.
Number of blades and of floats in each wheel, ...		2.	15.
Length of screw and size of each float, ...		4 ft. 8 in.	12 ft. $\times$ 4 ft. 6 in.
{ Pitch of screw (uniform) is six times its length, or		28 ft.	
{ Total surface in screw-blades and in all floats of both wheels, ...			1620 sq. ft.
Total number of boilers, ...		4.	4.
Total length of ditto, fore and aft, ...		43 ft. 6 in.	46 ft.
Breadth of ditto, ...		9 ft. 3 in.	12 ft.
Depth of ditto, ...		12 ft. 3 in.	18 ft. 9 in.
Number of furnaces, ...		24.	24.
Width of each, ...		2 ft. 10 in.	3 ft. 3 in.
Length of fire-bars, ...		7 ft.	7 ft.
Total area of fire-grate, ...		475 sq. ft.	546 sq. ft.
Total heating surface in boilers, ...		10,910 sq. ft.	16,640 sq. ft.
Total steam space, ...		2591 cubic ft.	2809 cub. ft.
Number of chimneys, ...		1.	2.
Diameter of each, ...		8 ft.	6 ft. 8 in.
Area of chimneys, total, ...		50 $\frac{1}{2}$ sq. ft.	70 sq. ft.
Pressure of steam in boilers, ...		14 lbs.	17 lbs.
TRIALS AT MEASURED MILE IN STOKE'S BAY.			
Date of trial, ...		Jan. 13, 1854.	Mar. 10, 1854.
Draft of water, forward and aft, ...	{	15 ft. 3 in. fwd.	16 ft. 4 in. fwd.
Ditto, mean, ...		18 ft. 3 in. aft.	18 ft. 8 in. aft.
Coal on board, ...		16 ft. 9 in.	16 ft. 6 in.
Speed of vessel in knots per hour, (mean of several runs,)		700 tons.	290 tons.
Ditto in statute miles, (ditto,)		13.78 knots.	13.97 knots.
Immersed midship section, ...		15.87 miles.	16.08 miles.
Displacement, ...		560 sq. ft.	544 sq. ft.
Revolutions of engines, (mean,)		3220 tons.	3070 tons.
Gross Indicated H. P., (mean of all runs,)		59.	18 $\frac{1}{2}$.
Coefficient of I. M. S., or speed in knots per hour cubed $\times$ I. M. S. $\div$ indicated H. P., ...		2050.	3070.
Coefficient of displacement or speed in knots per hour cubed $\times$ cube-root of square of displacement $\div$ indicated H. P., ...		716.	494.
{ Slip of screw per cent., ...		279.	171.
{ Ditto of paddles, taking axes of floats as centre of pressure, ...		15.	
			23.

The extraordinary fact which presses itself on our notice from the foregoing details of trials, consists, as it appears to us, in the difference of power required in the two vessels to produce a nearly identical speed. They are both built for the highest speed, and have fine lines, both in the forward and after bodies, the run of the *Himalaya* being longer and cleaner than the other, to suit the screw-propeller; and we must also remark that the *Atrato* had not been docked for some time previous to her trial, which was not the case with the *Himalaya*. But these circumstances will not by any means account for the fact, that 2050 H. P., economized by the screw, propelled the *Himalaya* at about the same speed as 3016 H. P., transmitted by paddles, propelled the *Atrato*. And the question naturally arises—By what means was the difference, or 966 H. P., absorbed or expended in the paddle steamer? And to this question we invite the earnest attention of our readers, for on its solution depends the extension of our knowledge of the screw-propeller, of the true nature of the action of which so little is thoroughly understood, as it in practice so often presents us with apparently anomalous results, and the value of which as a propeller for large ocean steamers (at any rate) has never been more prominent than in the example we have described.

In conclusion, we beg to say that, although we must decidedly express our opinion of the superiority of the screw over the paddle, as proved by the trials enumerated, it is our pleasing duty to bear ample testimony to the successful results obtained from both these noble vessels. They are magnificent specimens of naval architecture and of engineering skill, and both have highly distinguished themselves by their rapid voyages.

We will shortly lay before our readers some interesting investigations on the peculiarities developed by the screw of the *Himalaya* and other vessels.

On the construction of Buoys, Beacons, and other stationary floating bodies.

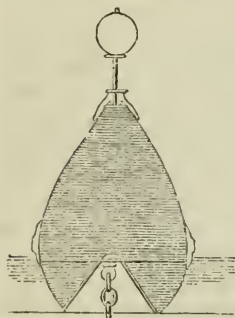
By Mr. G. HERBERT.*

Floating sea marks, as ordinarily constructed, were, it was stated, admitted to possess the defect of riding uneasily on the waves, under which they were frequently buried, so as to be scarcely visible, when most required; besides which, it was not an uncommon circumstance, in heavy weather, to find that a buoy had broken its chain and floated away. The present form of the buoys, and the fact of the mooring chains being attached to a point far below the centre of gravity, sufficiently accounted for these and other acknowledged defects, and induced the proposition of a form of stationary floating body, which should have a tendency to ride easily, and to retain its perpendicularity,—whilst the point of attachment of the mooring chain would be in such a situation as to subject it to the least amount of strain, and not be liable to draw the buoy down into the trough of the waves. With this view a wrought iron pear-shaped buoy was constructed, of a circular form in plan, and terminating above in an apex; the distribution of the weight was such that the centre of

* From Newton's London Journal of Arts and Sciences, December, 1855.

gravity was situated a little below the centre of the plane of flotation ; and the bottom was made concave and raised up internally, so as to form a cone, to the internal apex of which the mooring chain was attached.

This form was found so completely to answer the purpose, that several buoys were made by Messrs. Brown, Lennox & Co., for the Corporation of the Trinity House, and were pronounced to be superior to any previously built. A buoy 9 feet in height, 6 feet 6 inches in diameter, and having only 2 feet of the body submerged—exhibited, under all circumstances of wind and tide, an upright body of 7 feet out of the water. This quality of retaining its vertical position, arose from the force of the tide, or wave, being simultaneously exerted upon one side of the exterior of the buoy, and on the opposite side of the interior cone ; the forces so nearly balancing each other as to retain



the floating body in an almost perpendicular position.

Encouraged by the success of the first experiments, the Trinity House authorized the construction of a wrought iron sea beacon on the same principle. The floating base was 20 feet in diameter, divided by radiating bulk-heads into six water-tight compartments : it drew 4 feet 6 inches water, and supported a tower, also of wrought iron, 28 feet high, 7 feet diameter at the base, and 3 feet 6 inches diameter at the top—surmounted by an iron ball of the same diameter. This beacon was moored in the over-fall of the sea, at the South Sand Head of the Goodwin Sands, and was admitted to have been the best and most conspicuous sea-mark ever laid down. During very heavy storms it was observed, that the greatest angle assumed by the tower did not exceed 10° from the perpendicular, without any tendency towards circular motion. When it had been afloat for about five weeks, it was observed to sink gradually during very moderate weather, evidently from having sprung a leak. It was conjectured, that this casualty arose from the mooring chain having been improperly fixed in the hawse-pipe of the cone, instead of being below it, and thus that the links were brought into contact with the plates of the compartments, which, being only $\frac{3}{8}$ ths-inch in thickness, were soon chafed through, probably in several places simultaneously,—and the several compartments becoming filled with water, the beacon was submerged. The recurrence of such casualties in similar structures could, in future, be easily remedied, by attaching the mooring to the proper point in the cone, as is done in the buoys,—and thus guarding against the possibility of any friction against the body of the water-tight compartments.

It was now proposed to carry out this principle of construction upon a larger scale,—and to erect upon the floating base a tower sufficiently large to serve as a substitute for a light-house. A plan for such a structure, as submitted to the Trinity House by Sir Charles Fox, was described. The floating base was 80 feet in diameter, and drew 20 feet water ; the tower was 130 feet high, 24 feet in diameter at the base, and 14 feet at the lantern ; the weight of the tower and lantern was 117 tons, and the total displacement of the whole building was 1602 tons,—the centre of gravity

being 2 feet 6 inches below the surface of the water. The weight of a double mooring chain, the links of which were $3\frac{1}{4}$ inches diameter, would be about 46 tons in about 30 fathoms of water, when under the greatest pressure of wind and tide; and the catenary curve would then be about 47° from the perpendicular. The extreme pressure to which the chain would be subjected afloat, would not exceed 92 tons. The security of this sea light-tower would depend upon its moorings, which, for greater certainty of holding, should probably be Mitchell's screw moorings, within certain limits of depth,—and if the chain, weighing 46 tons, was not considered sufficiently strong, any additional strength might be added, and would only have the effect of immersing the floating base a few inches more. In the event of any unforeseen occurrence causing the sea light-tower to break adrift, it could immediately, and with certainty, be brought up by a spare chain and anchor.

The extreme pressure of the wind upon this structure would not exceed 34 tons, and that would only cause the tower to incline about $1^\circ 28'$ from the perpendicular. The pressure caused by the speed of the tide, at four miles an hour, could be taken at 30 tons upon the immersed portion.

Some interesting observations, made by Mr. Douglass in 1853, at the request of the author, on the number, height, and speed of waves at the light-house in course of construction at Bishop Rock, the most westerly of the Scilly group, tended to confirm the opinion, that little or no inconvenience would result from the action of the waves, even in that exposed locality. The statement showed, generally, that waves which, when measured from the hollow to the unbroken crest, had a height of—

8 feet,	do.	35	in one mile,	and 8	per minute.
15 feet,	do.	5 & 6	do.	5	per minute.
20 feet,	do.	3	do.	4	per minute.

The new form of sea light-tower was proposed to mark the sites of shoals, or rocks, or islands, which were difficult of access. Light-houses for this purpose being generally required as warning, rather than as guiding lights, it usually was of little importance whether the light was exactly upon the point of rock from which it was intended to warn a vessel, or whether it was a short distance from it, so that the existence of the danger was made manifest.

It was submitted that this form of construction might be advantageously employed for “guiding” or “fair-way” lights. The problem of exhibiting lights of any considerable altitude in very deep water, had not hitherto been solved,—and, consequently, the majority of the lights now in existence were not those leading into a right channel, but those which warned from a wrong one,—and so long as that plan was followed, the system of lighting would be one-sided and defective. Practical men, however, now appeared to think that the old system should not be continued,—and as the sea light-tower was capable of being moored in any depth of water, however great, it might be placed midway in any channels, as an invitation to the right course, and thus insure to all vessels a safer and speedier navigation.

The light-house on the Skerryvore Rock occupied seven years in building, and cost upwards of £90,000; whereas, by means of the sea light-

tower, the same object might be accomplished in one year, at a cost of £30,000. The site of the Bell Rock could be equally efficiently marked, at a cost of about £20,000, instead of £60,000; and that of the Eddy-stone at about £15,000, instead of £40,000. And the new form of light-towers would possess the advantage of being accessible in all weathers.

The observations were limited to sea marks,—but if the principle of construction proved to be correct, it would evidently be applicable to floating forts, and to almost every other description of stationary floating body—several designs for which were exhibited.

November 20th, 1855.—In the discussion on Mr. Herbert's paper "*On the construction of buoys, beacons, and other stationary floating bodies,*" it was generally admitted, that most favorable reports had been received relative to the buoys; they were moored in extremely exposed situations, where they had proved their superiority, by being always visible, and deviating but slightly from the perpendicular, at times when buoys of the old form were almost entirely submerged, and were only visible at intervals, in a horizontal position, in the trough of the sea. There was no reason why a larger class of beacons, on the same principle, should not be equally successful; and it was probable that it might be extended to supporting floating lights. The latter, however, demanded experiment.

The present light ships were stoutly-built vessels, moored by the bows; and in heavy weather, although, comparatively speaking, they rode easily, there was great strain upon the cables, which sometimes snapped. On one occasion there had been three light-ships adrift at the same time in the North Sea. That they were seaworthy vessels, was proved by all three getting safe into the neighboring ports; but the shipping was endangered by their absence. This tendency to snap the cable was contended to arise from the rising and tugging of the vessels moored by the bows, which could not be the case with a circular-formed body moored from the centre of flotation.

It was urged against the new form, that although the principle of the conical bottom was strictly correct, there was a doubt whether, if the circular base was lifted up sideways by one wave, the succeeding sea might not strike it on the under side, and severely try the mooring; also, that the lamps in a tower of that height, oscillating on the tops of waves, would be liable to be extinguished, and would not be so easily trimmed as on board light-ships, where they could be lowered down on to the deck and changed in a very short space of time. It was the great "send" of the wave that had a tendency to break the mooring-chains, and by this the circular light-tower would be peculiarly liable to be affected, on account of its light draft of water. If the system of mooring from the centre of gravity and of flotation was the best, why not adapt it to some extent to the present light vessels, by mooring them from about one-third of their length from the bows, and thus keep the head always to the "send" of the sea?

It might be apprehended, that there would be considerable difficulty in changing the mooring-chains of the sea light-towers, in such situations,—and it was well known that all chain moorings did require to be changed at intervals. Such heavy chains would require much stowing space, and considerable power to handle them; and in case of one of these circular

floating bodies breaking from its mooring, it would drift at the mercy of the waves.

It was admitted that, for a floating battery, the new form appeared to be peculiarly adapted, as the circular shape would enable the guns to be worked all round. It could be towed, or worked slowly by screw propellers into a convenient position, which the light draft of water would enable it to attain; the concave bottom and centre mooring would keep it steady,—it would afford but an indifferent mark for the enemy's guns,—and its dome-shaped circular upper works and deck, composed of thick plates, would resist any shot, however heavy.

In reply to the objections, it was argued, that if the principle was admitted to be correct for buoys and beacons, there was every reason to anticipate eventual success with the larger structures. It had been conceded, that the point of attachment was in the right position, and that the rising and falling of the tower on the waves, would not have any tendency to fracture the chain. Now, this vertical motion was all that the tower was subjected to, as the "send" of the sea never could act against the under side of the base: any force of a wave acting against the outside of the base, even when it was floating on the crest of a wave, would act almost as much against the inside of the inner cone, and thus tend to neutralize the force; whilst the great weight of the mooring chain always keeping it in a large curve, gave ample scope for the vertical rise and fall of the tide, or of heavy waves. If the vibration of the beacon at the South Sand Head had been so small, the anticipations of such extreme oscillation in a sea light-tower, with a proportionate extent of base, were hardly well founded; and even then there were mechanical means of meeting the difficulty. The system of mooring from the centre did not appear to be adaptable to vessel-formed bodies; and as to the apprehended danger from a wave striking the new form of tower on the broadside, it must first be shown where the broadside of a circular body was to be found. As to the difficulty of changing the mooring when necessary, and of handling the massive chains, there should never be an admission of any insurmountable difficulty in mechanical arrangements. The same intelligence which had devised the means of raising the Britannia tube to its present position, would contrive the method of lowering and replacing it when it became necessary; and in comparison with that tube, what was the weight of a mooring chain, even although the actual space within the base of the tower was restricted for handling it in? As to the danger from drifting away, no doubt the circular body would be less manageable than a light-ship, if the latter could get up her sails and get her head well up; but, on the other hand, there would not be so much danger of getting into the trough of the sea,—and a comparatively small anchor would fetch the sea light-tower up, when it had drifted nearly to the shore. The external form of the base might probably be modified, by giving it the same curvature inwards above the water-line as there was below it, so that the waves should not have any hold upon the mass.

The question of the applicability of the new form to floating batteries, had only been slightly alluded to in the paper, because it had not been tried; but it must be evident, even to the comprehension of landsmen, how many advantages it offered; and as it was now recommended by eminent naval authorities, it was hoped that it would be tried.

It was announced that the Board of Trade had determined to try the system, by placing a large beacon in a very exposed situation off the north-west coast of Ireland.

It was further urged that, hitherto, nautical men had not any actual experience of the effect of mooring a large body from the centre of gravity and of flotation. A ship moored from the bows, now met and received the full force of each wave with its nose held down to the blow, whilst the after-part was free to move in any direction. Now there could not be any analogy between the action of waves upon two bodies of such dissimilar forms moored under such totally different circumstances. If the buoys of the new form had been as successful as was admitted, why should not the principle be gradually extended, to ascertain the proper dimensions for the light towers? The success hitherto obtained, afforded the greatest encouragement to persevere in endeavoring to perfect a system which was calculated to be of the greatest benefit to the nautical world. The general adoption of fair-way, or guiding lights, for main channels, would, it was contended, form a new era in the system of lighting,—at once double the safety of navigation,—and be the means of saving many valuable lives.

It was questioned, whether the proposed system of mooring lights in the middle of channels would not induce the risk of collisions between them and vessels under sail; and it was principally the fear of risking the lives of the light-keepers in vessels of such novel form and untried capabilities, that had prevented the Trinity House from trying the larger structure, as they had tried the buoys and the beacon. They had also dreaded the difficulty of replacing the light-tower in its position, in the event of its breaking adrift,—whereas the present light-ships were more manageable under such circumstances: such occurrences were, however, rare, and on an average did not exceed one or one-and-a-half per annum,—the fact of three light-ships being adrift at one time being quite an exceptional case.

It was submitted that no unconquerable objections had been raised to the system, but it had, on the contrary, been admitted to possess many and great advantages. It was evident that it was only requisite to bring the united skill of the sailor and the engineer to bear upon the question, and the desired end would be attained.

Description of a New Reflector for Lights.

Attention was directed to a new kind of reflector for lights: it was composed of silvered porcelain, and appeared to possess a very brilliant polish, which was stated to be indestructible. Hitherto reflectors of small sizes only had been produced, but by means now adopted, it was expected that they could be made as large as 21 inches in diameter over the mouth. If this manufacture was brought to the perfection that was anticipated, a great economy would result,—as the silvered copper reflectors at present used, were very expensive originally, were liable to oxidation, and were frequently injured by the carelessness of the attendants, in rubbing them to keep the reflecting surfaces bright. The new porcelain reflector had been transmitted by the Honorable Major Fitzmaurice to Capt. Washington, R. N., by whom it was introduced to the notice of the meeting.

For the Journal of the Franklin Institute.

On Hopkins's Self-acting and other Couplings for Cars. By THOMAS D. STETSON, Mech. Eng.

The English method of securing railway carriages together without any "slack," except such as is derived from the elasticity of the springs introduced—has never been introduced to any considerable extent in this country. We have striven for a simple, cheap, and durable style, one which would readily lock and unlock, which would allow sufficient angularity of the cars to avoid straining on curves, and exhibit sufficient strength and elasticity to resist the ordinary forces, both of extension and compression. Although even the most modern forms differ in materials, in proportions, and in weight, there are certain features possessed in common, which are universally decreed to be desirable. Among these are flat or slightly rounded faces to receive the pressure when crowded together, a simple link to resist the more legitimate tensile strain when stretched by the locomotive, and a shank of uniform section to allow of end play through the stirrup which supports it. The material has been both cast and wrought iron, and on some roads several forms have been employed, in which the fusible has been made to embrace a portion of malleable metal so as to form a mongrel—a cast iron face connected to the spring behind, by means of round bars of rolled iron. The New Jersey Railroad and Transportation Company, have a large number of the latter description, some of the heads being provided with two, and others with four parallel bars. The cast iron couplings are liable to break in the shank, particularly in frosty weather—the wrought iron ones involve quite a large amount of labor in forging and securing of the head, but the greatest fault in all the couplings—when properly apportioned and attached—is the necessity for the presence of an active man between the cars to effect the union. The danger attending this operation is greater than any other to which employees are exposed, and this is much increased when the cars come together with rapidity, or in the night, so that several forms of self-locking couplings have been devised to remedy or alleviate this evil.

It is usually, and would seem almost *necessarily* the case, that mechanism of any kind, designed to accomplish more or to work better, costs more either in construction or maintenance than the older styles, but this objection does not apply to a new self-locking coupling recently introduced on the New York and Erie Road, a fact, of itself, sufficiently important to secure the immediate attention of economical as well as philanthropic managers.

Mr. David A. Hopkins, Elmira, New York, is entitled to the credit of this invention, which acts on the same general principles as the ordinary ones described, but is made self-acting by the addition of a small piece which supports the pin until the link has entered. The pin is placed in position by hand at any time previous to the approach of the cars together, and rests with its lower end supported by the spring piece. As the cars strike together in the act of coupling, the link—previously placed in the

draw-head of the other car—enters the mouth, thrusts back the spring-piece, allows the pin to drop into place, and the cars are coupled.

To facilitate the entrance of the link, the mouth is constructed in a flaring form like a tunnel, but this must not be carried to extreme as it impairs the resistance to compression and percussion.

The material employed is partly wrought and partly cast iron, analogous to those above described, but the wrought shaft is of flat rectangular iron like the corresponding portion of the ordinary coupling. It costs a trifle less than the wrought iron draw-head, and appears to be the strongest form yet devised, as the pin drops through the wrought iron portion as well as the casting. It allows an equal or somewhat greater difference in height of cars than does the ordinary coupling, possesses none of the complexity or delicacy usually supposed to belong of necessity to any self-acting contrivance, and in case of derangement or failure of the spring, may be employed in precisely the same manner as those now in general use. This latter quality is worthy of special note.

The invention, in short, includes two distinct improvements: first, a mode of constructing stronger and cheaper draw-heads by properly combining wrought and cast iron; and second, a spring-piece to support the pin and render the device self-locking. This piece is connected in the simplest possible manner, by means of a bolt playing endwise in the wooden portion of the shank. The improvement, in its present form, is only applicable where the shank is or may be filled with wood.

The device possesses one property not yet alluded to, which widely distinguishes it from all self-acting couplings before proposed. Until a connexion is made with another car, the link must be supported entirely by one draw-head in the common form, the overhanging end invariably declines in obedience to gravity. In Hopkins's draw-head the spring-piece aided by a suitable form of the throat supports the link in a horizontal position or at any angle in which it may be previously placed. This is a most important quality, as without it the link could only with difficulty be made to hit the mouth in the opposite face, when the unavoidable variation in the height of cars is considered.

There are usually two distinct steps in every important improvement, the first to add parts, the second to simplify. Self-adjusting couplings containing a multiplicity of mechanism have been frequently proposed; but in this simple device, simplification seems to have been carried to its utmost limits before its introduction to the public.

Remarks.—We do not question the simplicity or efficiency of the coupling described by our correspondent, but if he will refer to Vol. xvi, p. 76 of our *Journal*, he will find the description of one possessing all the advantages claimed for this, in addition to others which are not without their value.

ED.

AMERICAN PATENTS.

List of American Patents which issued from December 25th, 1855, to January 15th, 1856, (inclusive,) with Exemplifications.

DECEMBER 25.

113. For an *Improvement in Candle Mould Apparatus*; Lewis C. Ashley, Troy, New York.

Claim.—"The combination of candle moulds, which have an opening in the side or tip end of each mould, to admit the melted tallow, with a device for temporarily closing the large open ends of said moulds, and simultaneously entering the wicks thereat, to make the but ends of the candles with a smooth finish. Also, the combination of said combined moulds, and device for closing the side or tip ingate openings in said moulds, to complete the formation of the parts of the candles at said ingate openings, by which the operation of scraping to complete the finish of the candles at these places is avoided."

114. For an *Improvement in Pipes of a Vapor Bath*; Joseph Buhler, M. D., City of New York.

Claim.—"The back distributing pipe with its sleeve, operated by a cord with a handle and weight, or by any equivalent means, the said sleeve having perforations out of line with the perforations of the pipe, to allow the patient to direct the concentrated vapor to any part of his back."

115. For an *Improvement in the Combination of Injecting Syringes*; Joseph Buhler, M. D., City of New York.

Claim.—"The combination of the receiver and pumps, provided with cocks."

116. For an *Improvement in Cranes*; Benijah J. Burnett, City of New York.

Claim.—"1st, The pendant segmental traveler and backstays, arranged to spread outwards from towards the top downwards, and whereby the "tripping out," or lateral displacement of the foot of the crane or segmental traveler is obviated, all twisting or binding avoided, and a perfectly free but steady action given the same, either as regards pressure in the vertical direction transferred to the top of the tower, or horizontal swing. 2d, The combination and arrangement with the segmental traveler, or swinging foot of the crane, of the circular or revolving frame of anti-friction rollers freely suspended on the tower, and rotating round the same, together with the swinging foot, or segmental traveler, by the horizontal pressure of the latter on the rollers, in contact with their bite, on or against the fixed bolt surrounding the tower."

117. For an *Improvement in Time Indicators*; George Byington, Rochester, N. Y.

Claim.—"The wire or ribbon."

118. For an *Improvement in Double-Acting Steam Brake*; Robert L. Curry, Philadelphia, Pennsylvania.

Claim.—"The employment of a cylinder, in combination with the brakes, on both sides of the wheels."

119. For an *Improvement in Rotary Pumps*; Thomas Crane, Fort Atkinson, Wis.

Claim.—"The combination of the hinged valve, with the eccentrically moving round piston, when said valve is of the shape, and is so arranged in relation to the pump chamber, the offset chamber, the suction pipe, and the eduction pipe, as to render it impossible for said pipes to be, for an instant, brought into connexion with each other, during any portion of the revolution of the piston."

120. For an *Improvement in Window Shades*; Thomas Danforth, Roxbury, Mass.

Claim.—"Making the frame so as to be capable of longitudinal contraction and expansion, in combination with applying the gauze shade or curtain thereto, and so as to wind upon a roller, and be wound thereon."

121. For an *Improvement in Machinery for Whipping Hair*; Isaac Davis, Mechanicsburgh, Ohio.

Claim.—"A combination of a series of long, slender, and elastic revolving rods, with

a similiar series of stationary rods, arranged and operating within a cylinder, for the purpose of whipping hair. Also, in combination with the foregoing, a register in the bottom perforated head of the cylinder, for the purpose of regulating the strength of the downward current in the cylinder, and insuring a due admixture of air with the whipped hair, as it leaves the machine."

122. For an *Improved Method of Hanging Saws*; Soranus Dunham, North Bridgewater, Massachusetts.

Claim.—"The improved mode of hanging the saw, when the frame in which it is hung has a reciprocating curvilinear motion, so as to provide for the necessary play of the same at its ends; said improved mode consisting in supporting and confining the saw at one end, or both its ends, in wedge-shaped steps, arranged to tilt in proper grooves. Also, the vertical stiffening and regulating bar, with its ends arranged in the wedge-shaped steps, and with one end made susceptible of adjustment."

123. For an *Improvement in Steam Boiler Furnaces*; Henry F. and Louis A. Gossin, Thibodeaux, Louisiana.

Claim.—"Constructing the flues of boiler furnaces with cross walls, or diaphragms perforated with passages."

124. For an *Improved Manufacture of Wrought Iron Cannon*; John Griffin, Safe Harbor, Pennsylvania.

Claim.—"The manufacture of wrought iron cannon, by forming the fagot or pile of longitudinal bars, surrounded by a series of bands of iron, and the welding together the whole mass, by passing it between rollers."

125. For an *Improved Mode of Dressing Mill Stones, for Scouring and Hulling Buckwheat, &c.*; Bishop J. Harris, Auburn, Pennsylvania.

Claim.—"The smooth and beveled dress of mill stones, for scouring and hulling buckwheat, by which method, the buckwheat is longer retained within the bosom of the stones, and more effectually scoured, without injury to the kernel, than by any other known mode."

126. For an *Improvement in Seeding Machines*; Reuben Hurd, Spring Hill, Ill.

Claim.—"The arrangement of the elevator, or belt, with its buckets or seed cups, with the conveying spout and seed box, the latter being provided with a spring valve or movable bottom opening upwards; and the said cups or buckets passing through said bottom, exclusively in or during the upward travel of the elevator."

127. For an *Improvement in Apparatus for Making Salt*; John P. Hale, Kanawha Court House, Virginia.

Claim.—"The two pans or kettles, placed one over the other on a fulcrum, in combination with the vat."

128. For an *Improvement in Paddle Wheels*; Benjamin Hill, Rochester, N. Y.

Claim.—"The radially hinged valves used as substitutes for paddles; said valves being attached to disks or rings, and supported thereby."

129. For an *Improved Method of Hanging Circular Saws*; Westel W. Hurlbut, Boonville, New York.

Claim.—"The arms as connected with the saw guides, the bearing and the opening wedge, in such manner as to adjust with the movement of the saw."

130. For an *Improvement in Machines for Mincing Meat*; Alexander Lichteiser, Reading, Pennsylvania.

Claim.—"The placing of the knives or blades in an inclined position, on the surface of the cylinder, for the purpose of propelling the meat through the machine."

131. For an *Improvement in Hoisting Blocks*; William H. Merrill, Taunton, Mass.

Claim.—"The roll, the upper socket or cap, and the lower pintle or step, used together."

132. For an *Improvement in Hulling Machines*; Charles Miller, Carroll Township, Pennsylvania.

Claim.—"The application of the block and adjustable slides, by means of which, I

can regulate the machine, so as to retain the seed in the huller, until it is perfectly shelled."

133. For an *Improvement in Proportional Dividers*; Henry M. Parkhurst, Perth Amboy, New Jersey.

Claim.—"Providing an ordinary pair of dividers, with the secondary legs, which have their joints equidistant from the primary joint, and at right angles thereto."

134. For a *Combined Log and Sounding Line*; Adolphe Pécoul, Marseilles, France.

Claim.—"The sounding log, constructed, that is to say: composed of a buoy, having applied to it a weight, attached to a line passing between a pulley and a spring, or its equivalent, at the bottom; whether used with or without a connexion, to connect the line with the top part of it; the whole constituting an instrument, by which the speed of a vessel may be measured, by which soundings may be taken, without stopping or heaving to."

135. For an *Improvement in Fountain Pens*; Newell A. Prince, Brooklyn, N. Y.

Claim.—"1st, The elevator or bead, on the back part of the pen near its heel; being designed to keep the pen, by coming in contact with the inside of the main reservoir tube, from lifting too much. 2d, The pen notched near its heel, and the combination of the same with the feeding tube, correspondingly notched, so that the two placed together, and affixed in the main reservoir tube, the pen cannot get out of its position."

136. For an *Improvement in Mills for Grinding Grain, &c.*; Ezra Ripley, Troy, New York.

Claim.—"Combining with a continuous rotating grinding cylinder or plates, one or more grinding cylinders, which have a partially rotating reciprocating motion in opposite directions given to it or them by the cams, lever, and spring, (or by other analogous devices for the same purpose.)"

137. For an *Improvement in Corn Shellers*; James Bobb, Lewistown, Pa.

Claim.—"The hood or casing, in combination with the concave fender board or cob arrester, and cylinder, for the purpose of directing a blast, and separating or cleaning the corn and cob."

138. *Improved Extension Bit*; John P. Rollins, Boston, Massachusetts.

Claim.—"The manner in which the lip and cutter are set, (or secured,) for operation, when being adjusted, without the use of separate screws for that purpose."

139. *Improvement in Revolving Fire Arms*; E. K. Root, Hartford, Conn.

Claim.—"Combining the driving pin that works in the grooves, to rotate and hold the breech in line with a slide below, adapted to the reception of, and to be operated by the trigger finger, and acting on the lock, at the end of the back motion, to liberate the cock or hammer, to discharge the load."

140. For an *Improvement in Looms for Weaving Wire*; George W. Smith, Mauch Chunk, Pennsylvania.

Claim.—"1st, Giving the reed two movements, the first for squaring the filling with the warp, and bringing it to a suitable position to be operated upon by the crimpers; and the second, to beat it up to its place. 2d, Giving the crimpers a movement laterally to the warp, in opposite directions, alternately, after the crimping operations, for the purpose of making them adapt themselves to the varying intersections of the successive wires of the filling and the warp."

141. For an *Improvement in Breech Loading Fire Arms*; Gilbert Smith, Buttermilk Falls, New York.

Claim.—"1st, The eccentric and traverse motions combined for opening and closing apertures, by means of a cap, perforated eccentric, to itself. 2d, Closing the aperture by means of an inserted screw pin being screwed forward direct from the cap, when the eccentric throws it direct over the axis of aperture."

142. For an *Improvement in Corn and Cob Mills*; Thomas B. Stout, Keyport, N. J.

Claim.—"The adjustable regulator, regulated and operating in connexion with the bur and shell. Also, coupling the spindle to the bur, and adjusting it therein, by means of the recess and pin, and the radial regulating rods, and in combination therewith, the

adjustment of the upper end of the spindle in the frame, by the rods or their equivalents, so that the two adjustments may harmonize with each other, and no disarrangement of the bur in its shell may arise, in the application of the power to the upper end of the spindle. Also, the auxiliary bur, dressed in the direction opposite to that of the main bur, and so arranged that it may revolve nearly or quite in contact with, and adapt its position to that of its shell, unrestrained by the parts by which it is attached and driven."

143. For an *Improvement in Hand Seed Planters*; Ancil Stickney, Concord, N. H.

Claim.—"Combining the plunger of said planter to any suitable portion of the seed box, by means of a spring, of sufficient thickness to prevent said plunger, in operating the planter, from sliding downwards on the seed box, and opening the planting receptacle, before said receptacle has penetrated to the desired depth into the ground, to deposit the seed contained in it."

144. For an *Improvement in Sad Iron Heaters*; Jesse D. Wheelock, Mayville, Wis.

Claim.—"The use or application of the spiral springs within the tubes, in combination with the tube and lids."

145. For an *Improvement in Hydraulic Oil Presses*; William Wilber, New Orleans, Louisiana.

Claim.—"The manner of constructing the cylinder of a hydraulic press, viz., of staves of wood, when lined with copper or other suitable metal as well as double banded. Also, the making of the bed plates of sections of wood, having the end of the grain of the wood in a line with the thrust with the piston or platen, for the purpose of using the elasticity of the wood, and thus relieving the press from the rigidity of metal and for lightness and cheapness of construction, and also, for enabling me to arrange the through bolts, so as to divide the strain upon them and prevent their crushing the wood. Also, the manner of uniting the through bolts or rods with the bed plates, viz., by means of the collars let into the separate sections of wood for relieving the heads of the bolts of the strain and distributing the strain throughout the bed plates. Also, in combination with the seed boxes, the introducing of steam directly into the seeds in said boxes, in contradistinction from heating them, by conduction or radiation, so as to have both heat and moisture in the boxes. Also, the hinging of the door and one of the sides of the box to the other sides, so that, drawing out the rod, the door of the box will spring away from the plates, and one side will, at the same time, give slightly but sufficiently to release the cakes from the said pressure, thus allowing them to be easily lifted out or removed."

146. For an *Improvement in Guards for Lanterns*; Charles H. Butterfield, Nashua, New Hampshire, Assignor to Amory Houghton, Boston, Massachusetts.

Claim.—"Mode of making the guard, viz., elastic or with springs at top and bottom, to embrace the neck and lower part of the lantern, the same not only dispensing with hinges, but serving to maintain the guard in place even when its clasp may be unhooked."

147. For an *Improvement in Revolving Grates*; Charles Evans, Charlestown, Mass., Assignor to self and George K. Goodwin, Roxbury, Massachusetts.

Claim.—"The method of hanging the cylinder within the recesses in the sides of the stove, and of raising the grate to its upright position."

RE-ISSUES FOR DECEMBER, 1855.

1. For a *Machine for Sticking Pins in Paper*; Samuel Slocum, Providence, Rhode Island; patented September 30, 1841; extended seven years from September 30, 1855; re-issued December 4, 1855.

Claim.—"Separating the pins, laterally, one by one from the lower end of a pile, sliding by gravity between guides by combining with such channel way between guides a grooved or notched instrument, so that when the groove or notch is brought in the line of the channel way, the lowest pin of the pile shall enter the groove or notch, and by the lateral motion, separate it from the pile without any conflict of the heads, the surface of the said instrument beyond the groove or notch acting as a stop to prevent the farther descent of the pile until a groove or notch be again brought in line, substantially as set forth. Also, the channel way between guides, for the descent of the column

of pins, by gravity, in combination with one or more guide grooves and one or more followers working in the said guide grooves, whereby the pins, after being separated, can be transferred. Also, in combination with one or more guide grooves and one follower connected therewith for guiding the pin or pins as pushed forward, the employment of a clamp or holder for clamping or holding the paper in the required position during the operation of inserting the pin or pins. And, finally, the combination of the channel way for the column of pins between guides, the guide, groove or grooves, or notches, the follower or followers, and the clamp, or equivalent therefor."

2. For an *Improvement in Mortising Machines*; Joseph Guild, Cincinnati, Ohio; patented November 30, 1852; re-issued December 11, 1855.

Claim.—1st, The sliding wrist connected with the chisel, and, also, with the driving power, in combination with the mechanism, or its equivalent, for sliding said wrist, so that the operator can, during the motion of the machine, vary the depth of cut of the chisel, or cause it to be suspended without disconnecting the driving power. 2d, The combination in a mortising machine of treadle and opposing spring or weight, connected to a toggle, one end of which being pivoted to the frame, the other is pivoted to a sliding wrist upon a vibrating arm, actuated by the power, the said wrist being slid out and in upon the arm with varying power and speed by the action of said toggle and its attached weight or spring and treadle."

3. For an *Improvement in Reaping and Mowing Machines*; Samuel Rockafellow, Coatsville, Pennsylvania; patented July 3, 1855; re-issued December 11, 1855.

Claim.—"Raising and depressing the finger bar, and, consequently, the cutters by means of the vertical bars, having wheels at their lower ends, arm attached to the cross-piece of the bars, lever, and shaft, with its arm attached. Also, supporting the ends of the stationary cutters by means of the sockets, or their equivalents, in the knobs or projections of the fingers."

4. For an *Improvement in Spark Arresters*; Wm. C. Grimes, Philadelphia, Pa.; patented February 12, 1842; re-issued December 25, 1855.

Claim.—"The combination of the central chamber, the series of tangential openings, the larger circular chamber furnished with a series of vertical openings leading into exterior chambers or channels, for separating sparks and other particles of matter from the gaseous current discharged from locomotive and other chimneys."

5. For an *Improvement in Sofa Bedsteads*; Charles F. Martin, Boston, Massachusetts; patented June 6, 1854; re-issued December 25, 1855.

Claim.—"Drawing down or depressing the cushion at the joint between the back and seat by means of the cords, or their equivalents, connected automatically with the seat and back."

DESIGNS.

1. For *Parlor Stoves to Burn Wood*; Conrad Harris and Paul W. Zoiner, Cincinnati, Ohio, December 11, 1855.

Claim.—"The design, configuration, and arrangement of the several ornaments, to be known and called 'Parlor Gem.'"

2. For *Clock Frames*; Jonathan C. Brown, Bristol, Connecticut, December 11, 1855.

Claim.—"The combination of the octagon form with the oval corner, as distinguished from some other form."

3. For a *Parlor Stove to Burn Coal*; Conrad Harris and Paul W. Zoiner, Cincinnati, Ohio, December 11, 1855.

Claim.—"The design, configuration, and arrangement of the several ornaments for a coal parlor stove, to be known and called the 'Carbon.'"

4. For *Six Plate Box Stoves*; Conrad Harris and Paul W. Zoiner, Cincinnati, Ohio, December 11, 1855.

Claim.—"The mouldings, flutes, and scrolls, to form an ornamental design for six plate or box stoves."

5. For *Cooking Stoves*; Conrad Harris and Paul W. Zoiner, Cincinnati, Ohio, December, 11, 1855.

Claim.—"The configuration and arrangement of the several ornaments, forming a new and original design for premium cook stoves, to be known and called the 'Kansas.' "

6. For *Strap Hinges*; Enoch Woolman, Damascoville, Ohio, December, 11, 1855.

Claim.—"The design for strap hinges to be made of malleable cast iron, ornamented by the straight, curved, and annular ribs."

7. For *Ships' Caboose Stoves*; A. A. Lincoln, Jr., Norton, Massachusetts.

Claim.—"The new design for a cooking stove, consisting of the bar moldings, rivets, and bead or scalloped moulding."

8. For *Table Knives and Forks*; Joseph W. Gardiner, Assignor to Lamson, Goodnow & Co., Shelburne Falls, Massachusetts, December 25, 1855.

Claim.—"The part marked."

JANUARY 1, 1856.

1. For an *Improvement in Furnace for Soldering*; Philo Brown, Waterbury, Conn.

Claim.—"Combining the brazing or soldering chamber with the fire chamber and chimney, and interposed between the two, when the said brazing or soldering chamber communicates with the fire chamber by means of one or more apertures at or near the top, and one or more apertures at or near the bottom, governed by dampers, or equivalents therefor."

2. For an *Improved Chain for Power Press*; Nathan Chapman, Mystic River, Conn.

Claim.—"The so making of a chain for power presses, as that it shall recede gradually from a straight line, and the links diminish in length as they extend from the wheel on which they are to be wound to the follower."

3. For an *Improved Method of Operating and Lubricating Slide Valves*; James Cochran, City of New York.

Claim.—"1st, Moving a vibrating flap or curved slide valve within its chest without the necessity of a stuffing box. 2d, The method of lubricating slide valves by and through an aperture of the valve or its seat."

4. For an *Improved Nut Box*; Richard Cole, St. Louis, Missouri.

Claim.—"The arrangement of the segments, the eccentrics, and the set screws with each other and with the case."

5. For an *Improvement in Brick Presses*; John B. Collen, Reading, Pa.

Claim.—"The employment of stationary mould boxes, in combination with the vertically moving gate (actuated substantially as set forth) and the intermittent action of the pistons, whereby the brick is pressed and delivered by a single piston."

6. For an *Improvement in Ploughs*; George W. Cooper, Ogeechee, Georgia.

Claim.—"Uniting the handles of the plough to the standard thereof by means of the self-adjusting elbow joint, so that both the handles and the plough shall be susceptible of the same relative adjustment to the beam."

7. For an *Improvement in Safety Guards for Railroad Cars*; John G. Crocker, Utica, New York.

Claim.—"The shield and the movable platform to be attached to railroad cars for preventing accidents, and though both are necessary to effect this purpose fully, yet I claim them separately as well as in combination."

8. For a *Wind Mill*; Benjamin Feun, Hartford, Ohio.

Claim.—"The horizontal movable wing with unequal sides and hung upon eccentric pivots, in combination with the governor. Also, the method of governing and releasing the wings in high winds by means of the pendulum and rod, in combination with the wheel or counter balance."

9. For an *Improved Printing Press*; George P. Gordon, City of New York.

Claim.—"1st, Combining with such rotating disk and annular disk, which shall re-

volve around and in a contrary direction to it (for the purpose of distributing the ink.)
 2d, Throwing the same rollers, one or more, used for inking the form, from the parallel position they necessarily occupy for this purpose, to an oblique position, which shall give to them a lateral motion when in contact with the distributing disks, or equivalent.
 3d, A rotating reciprocating cylinder or segment of a cylinder, in combination with a reciprocating bed, when such bed shall have a movement to and from such cylinder.
 4th, So placing the bed when used with a rotating reciprocating cylinder or segment of a cylinder which shall drop or pile the printed sheets underneath it."

10. For an *Improvement in Repeating Fire Arms*; Benjamin Grooms, Cumberland Township, Green County, Pennsylvania.

Claim.—"The mechanism for rotating the hammer during its reciprocating rectilinear movements, or rearward motions, consisting of the spring dog or stud, the series of straight grooves, and the series of helical grooves formed in the hammer shank, and arrangement with respect to each other, so that the spring dog may operate on them."

11. For a *Spoke Shave*; Elijah Holmes, Lynn, Massachusetts.

Claim.—"Supporting the ends of the knife or planes on shoulders inclined or arranged with respect to the bearing of the stock, and so as to enable the distance of the cutting edge of the knife from the said bearing surface to be changed."

12. For an *Improvement in Shirt Collars*; Walter Hunt, City of New York.

Claim.—"Uniting only the extremities of the lower edges of the pieces to the neck band, by means of any suitable fastenings, for the purpose of enabling a flat sided collar to fit easily and gracefully about the face."

13. For an *Improvement in Machines for Pegging Boots and Shoes*; Waterman B. Johnson, Sandwich, New Hampshire.

Claim.—"1st, The vibrating jaws for feeding the shoe. 2d, The combination of lever, stop, and swinging jack, for submitting the surface of the sole to the awl, to a given angle in every position. 3d, The adjustment of the drivers on the perimeter of the cam. 4th, The double binding slide clamps for securing the last in the jack."

14. For an *Improvement in Smoke Houses*; Moses Kendall, Cincinnati, Ohio.

Claim.—"The smoke furnace, or its equivalent, and its application to smoke houses thereof, which will prevent the fire from reaching the meat or the grease from reaching the fire, thereby preventing damage to the meat and smoke house."

15. For an *Improvement in Sewing Machines*; Phineas L. Slayton, Madison, Ind.

Claim.—"1st, The horizontal motion of the needle and shuttle box combined at any required distance from the cloth. 2d, The combination of mechanism, by which the pattern receives motion and operates to control the movements of the needle and shuttle, consisting of the worm wheel and screw, or their equivalents, of which the screw or their first mover is furnished with arms operated upon by a lever on a shaft which receives a continuous rotary motion. 3d, Furnishing the revolving shuttle with a revolving bobbin or ball containing the thread and spool, by which the twist of the thread remains unchanged, or their equivalents. 4th, The manner of connecting the fly with the feeding hook, as it is so operated upon by the thread as the shuttle passes through the loop to prevent missing stitches. 5th, The feeding apparatus attached to the revolving turn table."

16. For an *Improved Gold Amalgamator*; Daniel Liebee, Middletown, Ohio.

Claim.—"The use of the reservoir and spout, in connexion with the revolving pan and scrapers, operating with the stationary trough and agitators."

17. For an *Improved Pump*; Charles N. Lewis, Seneca Falls, New York.

Claim.—"The basin, or its equivalent, and in combination and connexion therewith, the arrangement and construction of said pump."

18. For an *Improved Machine for Making Eave Troughs*; Orson E. Mallory, Castile, New York.

Claim.—"The use of the semi-cylindrical shaft, metallic sliding bar, and the end rollers."

19. For an *Improvement in Harvesters*; John H. Manny, Rockford, Illinois.

Claim.—"The tongue with an adjustable joint."

20. For an *Improved Bed for Lath Sawing Machines*; Thomas R. Markillie, Winchester, Illinois.

Claim.—"The combination of the bed with the longitudinal bearing guides. Also, the construction of the conformable dogs."

21. For an *Improved Sash Lock*; Joseph Marsh, Rochester, N. Y.

Claim.—"The construction and arrangement of the plates, the lever, and bolt, said bolt having the secondary locking notch at *d*."

22. For a *Pump*; James Neal and Charles W. Emery, Boston, Massachusetts.

Claim.—"Supporting the brake posts by means of an annular ring made to encircle and rotate on the neck of the base plate and be screwed or fastened to it."

23. For an *Improved Padlock*; I. J. Oldis, Wheeler, New York.

Claim.—"The use of spring, catch, and lever, arranged and operating in connexion with the lips and springs."

24. For an *Improvement in Hay and Cotton Presses*; Joseph Peevy, Passadumkeag, Maine.

Claim.—"The combination of the laterally moving beam with the swinging follower."

25. For an *Improvement in Automatic Electrical Circuit Breakers*; Charles Robinson and Charles T. Chester, City of New York.

Claim.—"The manner in which the detent of the clock work is let down to take effect, viz: by means of the lever pushing back a spring, which previously held the detent in its elevated position."

26. For an *Improvement in Steam Boiler Alarms*; Thomas Stubblefield, Columbus, Georgia.

Claim.—"The combination of the flexible lever with the float and alarm valve."

27. For an *Improvement in Repeating Magazine Fire Arms*; John C. Smith, Camden, New Jersey.

Claim.—"1st, The trigger with its spring link, lever with its dog and projection; the hammer with its notch for receiving the dog, its projection and spring, the lever link with its spring; lever, link, and lever, or the equivalents to the above, in combination with the vibrating breech, the whole being constructed and arranged for the purpose of imparting to the said breech the required lateral vibrating movement, retaining the same when required, and operating the hammer so as to discharge the load by simply operating the trigger only. 2d, The magazine containing the cylinder with its hollowed flanches and spring catches, in combination with the ratchet teeth on the cross-piece, and the ratchet wheel on the end of a vibrating breech, so that the movements of the latter may cause the said cylinder to carry round in succession a cartridge ready for insertion into the chamber of the breech. 3d, The sliding rod with its rod and projection, for the purpose of allowing the operator a ready means of inserting the cartridges into the chamber. 4th, The cap reservoir with the cylinder and its orifice for receiving the caps, in combination with the rod, arranged for the purpose of readily placing the caps on the nipple of the breach."

28. For an *Improvement in Velocimeters for Vessels*; Ira F. Thompson, City of New York.

Claim.—"1st, The combination of a water leaking piston or pistons with the drag, whereby the drag being hinged at or near the bottom of the vessel, indicates by its inclination the speed of the vessel, and said water leaking piston or pistons act to prevent a sudden motion to said drag, as the vessel pitches. 2d, The method of communicating motion from the drag or paddle to an indicator by means of the link guides, and retained vertically by the arm."

29. For an *Improvement in Grain Binders for Harvesters*; George W. N. Vest, Fort Gibson, Miss.

Claim.—"The double reciprocating compressor for gathering and compressing the grain against the stationary compressors ready for binding."

30. For an *Improvement in Compositions for Treating Wool*; Andrew H. Ward, Jr., Boston, Mass.

Claim.—"The employment of neutral salts with the alkaline carbonates and the oleic acid."

31. For an *Improved Arrangement of Feed Rollers for Planing Machines*; Hiram C. Wright, Worcester, Mass.

Claim.—"Governing the motion of the movable feed rolls by means of the jointed levers and connecting rod or its equivalent, whereby I am enabled to keep their surfaces parallel with the middle one, and thereby feed the board on a line with the surface of the table."

32. For a *Hydro-Pneumatic Pump for Diving Bells*; George Williamson, Brooklyn, New York.

Claim.—"1st, The arrangement and combination of the pump cylinder, chamber, and their valve arrangement, by which a proper supply of water is kept up and the air pumped. 2d, Refrigerating the air by extracting the caloric therefrom after it has passed the pump, by means of the water bath surrounding the valve chamber, and eduction tubes. 3d, The float reservoir, connected with the eduction pipe for separating the water from the air."

33. For an *Improvement in the Manufacture of Leather Shoe Binding*; Joshua Turner, Charlestown, Mass., Assignor to W. Covell, Dedham, Mass.

Claim.—"The improved process in the manufacture of leather bindings, viz: dividing a sheet of leather into strips of equal widths, joining or connecting them at their ends, so as to connect them into one long strip, coloring the same when so formed, and finally splitting it so as to remove the fleshy surplus portion, and reduce the whole to one equal thickness."

34. For an *Improvement in Screw Machines*; Cullen Whipple, Assignor to the New England Screw Company, Providence, R. I.

Claim.—"The combination of a series of grooves, in a moving surface, with a smooth guard and gripping plate. Also, the nicking saw mounted on the oscillating eccentric bearing resting in cylindrical boxes, in combination with mechanism for preventing and holding the blank."

35. For an *Improvement in Treating Oils*; Philo Marsh, South Adams, Mass., Assignor to Marsh & Howland, South Acton, Massachusetts.

Claim.—"The purpose of defecating oil, the employment of the pyroligneic constituents of crude pyroligneous acid, except the acetic acid."

36. For an *Improvement in Harvester Raking Apparatus*; George A. Clarke, Assignor to William Clarke, Philadelphia, Pennsylvania.

Claim.—"Operating the rake by means of the endless belt, in combination with the levers, connected with the rods, for the purpose of raking the cut grain from the platform."

JANUARY 8.

37. For an *Improvement in Ploughs*; Benjamin F. Avery, Louisville, Kentucky.

Claim.—"The lock joint for holding the landside to the short landside and mould board, the same consisting mainly of a shaped projection, hook, and flanch, and their counterparts, in the short landside. Also, the ears or lugs, cast on the inside of the mould board, for the purpose of fastening the mould board handle."

38. For an *Improvement in Making Illuminating Gas*; N. Aubin, Albany, N. Y.

Claim.—"Mixing the materials from which the gas is to be generated, with porous or coarsely divided substances, which are slow conductors of heat, and introducing the mixture into the retort, in a vessel with a perforated bottom, so constructed as to compel the contents of the vessel, expelled by the heat, to escape at the lower end, near to or in contact with the bottom of the retort, where the heat is the most intense."

39. For an *Improvement in Harvesters*; Lebeus Barnes, Islip Township, N. Y.

Claim.—"The application to the reciprocating cutter bar of a mowing machine or reaper, of a spring or springs, driven by or operating in connexion with the cutter."

40. For an *Improved Mode of Hanging Double Doors*; Charles E. Brown, City of New York.

Claim.—"Connecting double doors, by an endless chain passing around pulleys on the shafts or axis of the doors or by gearing, arranged in any proper way, so that as one door is opened or closed, the other will be moved simultaneously in a similar or opposite direction."

41. For an *Improvement in Constructing the Bottoms of Ships and other Vessels*; Samuel W. Brown, Lowell, Massachusetts.

Claim.—"Making the entire bottom and keel of ships and other vessels, of thick and continuous plates of metal, for the united purposes of bottom and ballast."

42. For an *Improved Machine for Sheet Metal Bending*; Reuben Brady, City of New York.

Claim.—"Placing the upper roller in an adjustable or swinging frame, and attaching the guide or feeding plates to said frame, when the above parts are used in connexion and operate conjointly with the permanent roller and concave bed."

43. For an *Improvement in Coal Scuttle Covers*; Irah Chase, Jr., Boston, Mass.

Claim.—"1st, Hanging to the cover a circular hoop, in combination with the prop and receiving hole. 2d, The arrangement by which the cover is fastened down, *i. e.*, by making the projection of the hoop and the ear operate as an automatic latch."

44. For an *Improvement in Bee Hives*; George H. Clarke, East Washington, N. H.

Claim.—"The construction and arrangement of the hollow bars."

45. For an *Improvement in the Form of Building Bricks*; Edgar Conckling, Cincinnati, Ohio.

Claim.—"The bricks having marginal ribs, skirting three sides, and a central rib across the middle of the bottom surface, (or of the top and bottom surfaces thereof,) said ribs enclosing cavities adapted for the reception of grouting, in combination with coving on the inner edge, affording passage for the grouting from above, to the cavities below the bricks."

46. For an *Improvement in Disinfecting Fecal Matter*; Dominique Emile Coutaret, Boston, Massachusetts.

Claim.—"The use of the ingredients named, for deoxidising feculent or other decomposing organic matter, and converting said matter into a manure."

47. For an *Improvement in Street Paving Machines*; Thomas Davidson, Jr., Kensington, Pennsylvania.

Claim.—"The rammers operated by the lifting wheels, in combination with the ratchets and pawls, whereby the machine is moved along, either backwards or forwards, as the rammers perform their work. Also, the arrangement of the gearing, whereby the motive power employed to operate the rammers, may, by adjusting the wheel, be employed to drive the machine from place to place, when the rammers are not in operation."

48. For an *Improvement in Filing Saws*; Jacob Erdle, West Bloomfield, N. Y.

Claim.—"The use of the eccentric and the various parts co-operating therewith, for raising the file as it recedes, the lever, plate, and their connexions, for feeding the saw through one or more teeth, and for regulating the depth of the cut, and its angle."

49. For an *Improved Watch Key*; Morris Falkenan, City of New York, Morris Pollak and Solomon Wiener, Hoboken, New Jersey.

Claim.—"The key on the pipe, pressed into the groove by the spring, and sliding in said groove, which is closed at its outer end, and thereby causing said pipe to be turned by the case, compensating for wear, and also regulating the extent of motion of said pipe. Also, the trigger piece, combined with the stud spring, to remove said stud from the hole, and allow the pipe to be projected from the case."

50. For an *Improvement in Breech Loading Fire Arms*; I. H. Gibbs, Troy, N. Y.

Claim.—"Hanging the barrel at some point between the two ends, on a sliding and turning joint, in combination with the connecting of the said barrel of the turning and

sliding joint, by means of a joint link, with a hand lever, having its fulcrum in the stock or breech pin. Also, in combination with a sliding barrel, having the rear end thereof open, the employment of a fixed cylindrical breech pin, surrounded by an annular recess to receive the rounded edge of the barrel."

51. For an *Improvement in Attaching Hammer Heads to Shafts*; Charles Hammond, Philadelphia, Pennsylvania.

Claim.—"The socket with its projecting lips and the wedge, arranged and employed in connexion with the head and shaft."

52. For an *Improvement in Padlocks*; James Harrison, Jr., Milwaukee, Wis.

Claim.—"The combination of the shackle, sliding bolt and rods, and fitted within a solid body or case, constructed of suitable metal, whereby a strong, durable, and burglar proof lock is obtained."

53. For an *Improvement in Peg Cutters for Boots and Shoes*; Samuel R. Jones, Baltimore, Maryland.

Claim.—"The employment of the spring, in connexion with the curved surface of that end of the handle, (double levers) upon which the float is pivoted, for the purpose of rendering the float capable of self-adaptation to the surfaces to which it is applied."

54. For an *Improvement in Machinery for Making Weavers' Harness*; George L. Jenks, Providence, Rhode Island.

Claim.—"1st, The method of adapting the machine to the making of harness of different widths, by the application of movable head pieces of different forms, to the studs and its fellow, which form the end or outside studs of the range, and the application to the single depressers of a movable packing piece, and blocks or other variable guides. 2d, Guiding the operations of the arms which carry the fingers employed in forming the loops and knots to produce the eyes of the heddles, by means of a pin working in a slot in a plate, which is made variable by swinging on a stud, whereby the movement of the finger may be varied to any extent necessary, without varying its position, when in contact with its respective stud."

55. For an *Improvement in the Manufacture of Hats*; Joseph Johnson, New Orleans, Louisiana.

Claim.—"The application and use of the fabric in the construction of hat bodies, when the same is cut from the web, united together, and formed into hat bodies. Also, the metallic ring or annular plate, in combination with the "turn over" around the "square," for the purpose of preserving the proper circular form at the "square," when the fabric of which the "tip" is made is too light or thin to serve the purpose of such support."

56. For an *Improved Mode of Sawing Wet Fuel*; John F. Manahan, Lowell, Mass.; ante-dated, July 8, 1855.

Claim.—"The method of producing from wet vegetable matter, an useful fuel, by mixing it with coal tar, or other fluid bituminous matter of like character."

57. For an *Improvement in Gas Cooking Stoves*; Hiram B. Musgrave, Cincinnati, Ohio.

Claim.—"In combination with the concentrically arranged gas deflector, the gas burner with lateral vents, and capable of vertical adjustment; or equivalent devices."

58. For an *Improvement in Cheese Presses*; William C. Pancost, Geneva Township, Ohio.

Claim.—"The spiral grooved wheel, in combination with the self-adjusting wheel."

59. For an *Improved Machine for Loading Dirt Cars*; Charles Phillips, Detroit, Michigan.

Claim.—"The framing, with boxes and aprons, or leaves attached to it."

60. For an *Improvement in Horse Hay Rakes*; Randall Pratt, Marple Township, Pa.

Claim.—"Hanging the prongs or clearers so that they can vibrate, and connecting them to the devices which operate the teeth, so that they will be vibrated in an opposite direction, simultaneously with the teeth, to clear them of the crop gathered, and press it together on the ground."

61. For an *Improvement in Excavating Machines*; J. J. Savage, City of New York.

Claim.—"1st, The connecting of the scoop and staff of excavating machines, to the swinging post, by vibratory or oscillating arms or links, or their mechanical equivalents. 2d, The adjustable broom, in combination with the excavating scoop and staff combined. 3d, The combination of the vibrating or oscillating connecting arms or bars of the scoop staff, with the feed chain, windlass, gearing and sheeve pulley, for the purpose of automatically feeding the scoop downwards, simultaneously with its forward motion."

52. For a *Method of Preventing Bank Notes, &c., from being Counterfeited*; Christopher D. Scopyan, New Haven, Connecticut.

Claim.—"The application of oil colored paper, together with a fugitive ink, to the manufacture of bank notes and drafts, which will prevent the counterfeiting of the said bank notes and drafts, by photographic process, by transferring on lithographic stone, or by anastatic printing; using for that purpose, the combined action of the oil colored paper, and the fugitive ink, *i. e.*, the combination of the oil colored paper and the fugitive ink, which produces the desired result, and not the oil colored paper alone without the fugitive ink, nor the fugitive ink alone without the oil colored paper, but the protecting power resulting out of the combination of the oil colored paper and the fugitive ink, or any other substantially the same."

63. For an *Improvement in Blades of Mowing Machines*; Gustavus Stone, Beloit, Wisconsin.

Claim.—"Making the sections of which the grass cutting blades are usually made of two pieces of steel, with but one cutting edge upon each, and so placing them upon the bar, that there shall be a wedged-shape opening between the backs, closed at the points, and widening out towards the bar."

64. For an *Improved Mortising Machine*; William Stoddard, Lowell, Mass.

Claim.—"1st, The movable cutting spurs or their mechanical equivalents, for forming or cutting the heads or ends of the mortise, and without the machine being confined to the timber being mortised. 2d, The double inverted feed rack, in combination with the ratchet nut, which is fixed to the screw, or their mechanical equivalents, so this screw can be moved by the rack and ratchet nut, to feed down the spurs, and reciprocating cutter, so as to form the mortise in the wood."

65. For an *Improvement in Machines for Sawing Marble Obelisks*; Abraham Straud, Melton, Pennsylvania.

Claim.—"The combination of the divided toggle jointed shaft, with a hinged or adjustable section of the frame, so that two or more saw frames hung to and driven by said shaft may be worked in an inclined position to each other, but at right angles to the axis of motion, and so that the shaft saw gates and their guides, as well as the sectional or hinged frame, may all be adjusted simultaneously and held in adjustment."

66. For an *Improvement in Seeding Machines*; John G. Snyder, Wheatfield, Pa.

Claim.—"1st, The so arranging the openings in the seeding plates, that the machine can be converted from a drilling to a hill planting one, or vice versa, by changing the running direction of the movable plate. 2d, An improvement upon the machine of Snyder & Young, patented Feb. 28, 1854, viz: the arrangement of the convex seeding plate segmental opening, and seed receptacle or drawer, for admitting of the location of said drawer outside of the hopper, and in a more convenient position for the attendant."

67. For an *Improvement in Candle Sticks*; Abner Whitely, Springfield, Ohio.

Claim.—"1st, The socket having the openings. 2d, The combination of the socket openings and slide."

68. For an *Improvement in Cultivating Ploughs*; William E. Wyche, Brookville, North Carolina.

Claim.—"The arranging upon the share of the plough of one or more vertical cutters with a curved or inclined plate, at or near the rear outside of the share, for the purpose of dividing the furrow slice vertically, and turning the outer portion in towards the plough."

69. For an *Improvement in Corn Harvesters*; George W. N. Yost, Port Gibson, Mississippi.

Claim.—"The combination of the adjustable lifters, finger board, revolving sickle-

shaped knives, vertical adjustable frame, and the adjustable platform, for the purpose of harvesting corn."

70. For an *Improvement in Fire Arms*; James H. Merrill, Baltimore, Md.

Claim.—"The construction of the breech pin with a receptacle for tallow to lubricate the joint. Also, the depression in the breech pin, opposite the end of the bore. Also, the combination of the button on one end of the breech pin and the slotted plate, in connexion with which the button works, to secure the breech pin firmly in place, while the breech is closed, in combination with a catch, or the equivalent thereof, at the opposite end of the breech pin from dropping out, while the breech is open and the button in a line with the slot; by which means the breech is securely closed, while the charge is exploded, and the pin at the same time capable of being readily removed. Also, the arrangement of the rammer in the rear of the breech, in combination with the breech pin. Also, the construction and arrangement of the breech pin, the lever for turning the same, the trough to receive the charge and guide the rammer, in such manner that the lever when shut down upon the stock, will cover and protect both the rammer and charging channel."

71. For an *Improvement in Mowing Machines*; Henry Pease, Assignor to self and James Roby, Brockport, New York.

Claim.—"The slotted arm and rotating knife."

72. For an *Improvement in Harvesters*; John Reily, Hart Prairie, Wisconsin, Assignor to Talbot C. Doneman, Ottawa, Wis., John Heath, Sullivan, Wis., and John Reily, Hart Prairie, Wisconsin.

Claim.—"1st, The method of raising and lowering the cutter bar. 2d, The arrangement and combination of a raker's seat with a swinging platform. 3d, The adjustable grain guard or straightening board."

73. For an *Improvement in the Manufacture of Boots and Shoes*; Sylvanus H. Whorf, Roxbury, Mass., Assignor to self and Charles Rice, Boston, Mass.

Claim.—"Extending the cement not only through perforations in the upper, but in or through perforations made in or through the insole or the outer sole, or both, the same presenting great advantages in not only securing the parts together, but rendering them water proof, when the cement employed is of a character to resist water."

JANUARY 15.

74. For an *Improvement in Means for Supporting the Propeller, and Receiving the Rudder of Stern Propellers*; John Beattie, Liverpool, England; patented in England, September 5, 1850.

Claim.—"The construction of an open wrought iron stern frame, forming part with the keel of the vessel, and receiving the rudder."

75. For a *Variable Dial for Dividing Engines*; William H. Brown, Worcester, Mass.

Claim.—"Causing both the index and dial to rotate at the same time."

76. For an *Improvement in Extension Railroad Car*; Joseph S. Brown, Lowell, Massachusetts.

Claim.—"Extending the floor and sides of cars outwards laterally, by means of the racks and pinions and other machinery connected to them, or otherwise, so as to give a larger area to the floor, and also enlarge the capacity of the car."

77. For a *Machine for Feeding Sheets of Paper to Printing Presses*; Samuel I. Chapman, Charleston, South Carolina.

Claim.—"1st, Separating and detaching the uppermost sheet of paper on the feed board, from those underneath it, and properly presenting said sheet to the fingers, nippers, or other device, by which it is conveyed to the printing press, or to the form thereon, by means of the box, valve, and holder or lifter, operating in connexion with a vacuum produced in the box, and a blast in the tube, the vacuum and blast being produced by an air pump, or its equivalent. 2d, Operating the feed board, by means of the cams, plate, spring, and socket, and screw rod fitting into said socket, motion being given the socket by means of a collar attached thereto, by a feather, whereby the feed board is made to rise and fall, to convey the sheets to the holder or lifter, and the diminishing height of the pile of paper compensated for, and also, any irregularity in

the thickness of the sheets. 3d, The feed board, in combination with the valve, holder, or lifter, and bar, operating in connexion with the vacuum produced in the box, and the blast in the tube."

78. For an *Improvement in Apparatus for Curing Varicocele, Sterility, Impotency, and other Diseases of the Genital Organs*; Joseph Cheever, Boston, Mass.

Claim.—"Combining the electric plates of an elastic serotum sack, by chains, or such a series of electrical conductors, extending from one to the other, as will permit the necessary expansion or contraction of the sack to take place, without obstruction therefrom. Also, extending the connecting chain of the positive and negative plates, into and throughout one of the straps of the serotum sack, and thence into and through the body belt, so as to protect said chain from injury."

79. For an *Improvement in Machines for Heading Bolts*; H. M. Clarke, New Britain, Connecticut.

Claim.—"1st, The arrangement of the two heading dies, when operating in such a manner, that while neither die is in motion nor at rest, without a like action of the other, the one, or internal heading die, receives an abrupt accelerated motion towards the close of the joint advance movement of the two dies, by means of the arrangement of the dies in the general slide, in combination with the lever or its equivalent, acting in concert therewith. 2d, Giving the gauge the several intermittent movements, upwards, downwards, and laterally, whereby, after performing its office of gauging, it moves away, to give room for the heading dies to operate, and afterwards, suddenly descends, to detach the bolt from the clamp, and by said action or blow, to clear itself of any adhering scale or dirt."

80. For an *Improvement in Removable Flanch Bars for Securing the Glasses to Lanterns*; Hezekiah Crout, Baltimore, Md.

Claim.—"The application of the flanchd removable bar."

81. For an *Improvement in Heading Spikes*; Elisha H. Collier, Scituate, Mass.

Claim.—"Hanging the die plate or anvil upon centres or bearings, in such a manner that it can be reversed, or its under face brought uppermost, the said die plate or anvil being provided with a double set of die holes."

82. For an *Improved Method of Operating Fire Engines*; John P. Philo and George Cowing, Seneca Falls, New York.

Claim.—"The arrangement of the toggle, shaft, arm, and rods for operating the pistons."

83. For an *Improved Hydrant*; C. J. Cowperthwait, Philadelphia, Pa.

Claim.—"The cylinder fitted over the conical projection on the bottom of the case, said cylinder having valves within it, and an elastic cap or covering, through which the valve rod passes, and to which cap said rod is attached; the cylinder being secured on the conical projection by means of the bent rod and cap of the case."

84. For an *Improvement in Gas Burners*; Charles A. Cummings and Cortland Douglass, New London, Connecticut.

Claim.—"The interposition between two jets or streams of gas issuing from the same burner of a plate."

85. For an *Improvement in Lock Gate Valves*; Dewitt C. Cummings, Fulton, New York.

Claim.—"The arrangement and construction of valves or paddle gates for canal locks, whereby the sand and grit in the water is washed, and settles away from the bearings, instead of accumulating therein. Also, the stationary axis of the paddle, so secured to the framing that it may be turned when it becomes worn, so as to present a different portion of its surface to the bearing of the paddle."

86. For an *Improvement in Extension Tables*; Edward A. Curley, Westport, Conn.

Claim.—"Having the top of the main or stationary portion of the table made loose, and arranged upon or suspended by springs, and to move up and down in guides or ways."

87. For an *Improvement in Reefing Sails*; Henry D. P. Cunningham, Bury Hants, England; patented in England, November 30, 1850.

Claim.—"1st, The chafing spar, applied to the after-side of the sail yard, for sending

off the sail from the mast or rigging, when rolled around the yard. 2d, The radius bar, in combination with the bonnet head, in order to permit the top of the bonnet to blow out in harmony with the belly of the sail."

88. For an *Improvement in Fire Arms*; Joseph C. Day, Hackettstown, N. J.

Claim.—"1st, The improved construction of the cap feeding tube with a slide on one side, a row of holes in said slide, and another row of holes in the side opposite; the one for the purpose of moving the follower along, and the other to prevent the follower returning with the slide. Also, communicating the motion from the tumbler to the slide, by a vibratory arm, or its equivalent, and also adding a spring thereto, in combination with the elbow slot, whereby said slide may be readily connected and disconnected from the lock and cap tube. Also, extending the lower part of the main spring from its pivot to and causing it to rest upon the sear, at a point very nearly over its centre, in order to dispense with a separate supporting stud and sear spring, and also, to enable the lower part of said main spring to be made nearly equal in length and strength to the upper part."

89. For an *Improved Mode of Attaching Thills to Axles*; Allen Greene, Providence, Rhode Island.

Claim.—"The use of the leather, gutta purcha, or other similar substance, in attaching the thill or shaft to the axle"

90. For an *Improvement in Implements for Pruning Trees*; W. W. Harvey, Saltville, Virginia.

Claim.—"Having the shank or bar of the cutter or chisel, fitted within a socket attached to a proper handle; the socket being allowed to slide or work on the shank or bar."

91. For an *Improvement in Cotton Presses*; Caleb S. Hunt, Bridgewater, Mass.

Claim.—"The peculiar arrangement of the respective parts of my improved press, by which I am enabled, with a single lever, to impart either a weak and rapid movement, or a slow and powerful movement to the platen of said press, or to any one of similar construction, viz: a non-revolving male screw attached to the platen, is embraced by two or more matched and movable concentric screw-nuts, whose uniting threads and grooves have a less degree of inclination than the threads upon the said male screw, and which are arranged in such a manner in relation to said male screw and the operating lever as to produce, at will, the desired movements of the platen."

92. For an *Improved Method of Regulating Speed of Wind-Mills*; Frank G. Johnson, Brooklyn, New York.

Claim.—"1st, The method of regulating the velocity of the wind-mill and controlling the position of its fans, by the use of the weights with the springs, adjusted to slide from and towards the centre of the wheel upon the spokes, and connected to the fans, by means of the rods or their equivalents. 2d, The combination together of the brake wheel and the arms, for the purpose of setting the fans edgewise to the wind whenever desired."

93. For an *Improvement in Brick Machines*; Richard W. Jones, Green Castle, Ind.

Claim.—"Feeding the moulds underneath the grate and pressing roller, and discharging them therefrom, by means of the reciprocating carriage, springs, catch spring, and roller."

94. For a *Shingle Machine*; A. Kendall, Cleveland, Ohio.

Claim.—"1st, The arrangement of devices for operating the approximating knives, whereby the shingles are shaved to the desired taper, according to the length of the shingle. 2d, The manner of raising the driver from the slide to the slide, by means of the carriages acting on the arm on the end of the lever. 3d, The tumbler with the springs."

95. For an *Improvement in Grain and Grass Harvesters*; William F. Ketchum, Buffalo, New York.

Claim.—"Supporting the cutter bar and platform, when the implement is used as a grain harvester, by the bar or rod, in addition to the bar; said bar or rod being arranged or attached to the cutter bar and frame."

96. For a *Shingle Machine*; Samuel M. King, Lancaster, Pennsylvania.

Claim.—"The combination of cast iron boxes, with adjustable bottoms and sliding lids, operating with the knives in front alternately by connecting rods, so as to cut and regulate the size and taper of the shingle."

97. For an *Improved Steering Wheel Stopper*; William R. Lavender and Atkins Smith, Provincetown, Massachusetts.

Claim.—"Constructing a wheel stopper, and applying it so as to operate with the wheel and tiller, so that it may turn up and down on a hinge, and when down, embrace the wheel handle, and be supported laterally under the strain of the wheel."

98. For *Improved Bits for Boring Fellowes and Tenoning Spokes*; Horatio McGrath, Meigs Creek, Ohio.

Claim.—"The single twist auger, with a tapering shell pod, for the purpose of boring and tapering a mortise at one operation. Also, the tenon auger, with its auxiliary adjustable cutter, to reduce the superfluous timber, and with its finishing bits arranged to cut a tenon with a shoulder at right angles to its axis."

99. For a *Mortising Machine*; J. A. Merriman, Hinsdale, Massachusetts.

Claim.—"Operating the chisels and cutter by means of the reciprocating plates, attached to a plate and provided with slots, in which a pin attached to the wrist of a shaft works."

100. For an *Improvement in Safety Coal Hole Covers*; F. H. Moore, Boston, Mass.

Claim.—"The combination of the grating and rods with the cover."

101. For an *Improvement in Steam Stop-Valves*; James McNabb and Adam Carr, City of New York.

Claim.—"The attachment of the outer shell to the valve spindle, in such a way that it can be removed at pleasure, to repair the valve."

102. For an *Improvement in Machines for Dressing Mill Stones*; R. D. Nesmith, Lake Village, New Hampshire.

Claim.—"Securing the back end of the pick arm to a head attached to a sliding plate, the head being allowed to turn on the sliding plate, whereby the length of the pick arm may be increased or diminished, as desired, and also the position of the pick arm varied in the machine."

103. For a *Machine for Making Clothes Pins*; Ephraim Parker, Burlington, Iowa.

Claim.—"Attaching to a common lathe, a cutter working parallel with the mandrel, in connexion with a spout, the same motion operating both the cutter and spout. Also, in connexion with the above, a wheel and saw, the whole being a self-acting machine, taking square pieces of timber from the spout and converting them into cylinders and clothes pins, at a single operation. Also, the combination as above described, or any other combination substantially equivalent thereto."

104. For an *Improvement in Washboards*; Ira S. Parker, Sharon, Vermont.

Claim.—"Constructing the washboard of a series of cylindrical beaded bars, the ends of which are secured to boards, the heads of the bars being side by side in horizontal rows, so as to leave spaces between them."

105. For an *Improvement in Door Fastenings*; Reed Peck, Cortlandville, N. Y.

Claim.—"The combination of the spring with the gearing, by which the standard is rendered self-fastening."

106. For an *Improvement in Cargo Ports for Ships and other Vessels*; Charles Perley, City of New York.

Claim.—"The rim around the flanch that receives the bolts to secure the frame to the vessel; said rim receiving caulking on both sides, one against the vessel and the other against the shutter, thereby effectually preventing leakage."

107. For an *Improvement in Remelting Iron Scraps*; Abiel Pevy, Lowell, Mass.

Claim.—"My cast iron retaining vessel, with one or more perforations through it, or otherwise formed, the vessel being for receiving and retaining the iron dust, and then be enclosed on all sides, so that both the vessel and the cast iron dust it contains will be melted together."

108. For an *Improvement in Casting Metals*; Ezra Ripley, Troy, N. Y.

Claim.—"Instantaneously removing the air which ordinarily fills the mould, into an air-tight expansive chamber through crevice-like air passages, arranged for the purpose, immediately after the open mouth of the mould is immersed in the fluid metal."

109. For an *Improvement in Straw Cutters*; Samuel T. Sharp, Danville, Mo.

Claim.—"The arranging a circular knife and a circular guard upon a common pivot, so that they will revolve, one towards the other, until they meet, each traveling the same distance; or the arranging two knives (circular,) upon a common pivot, so that they will revolve towards each other until they meet."

110. For an *Improvement in Ditching Machines*; Thomas J. Stratton, Waterloo, New York.

Claim.—"The secondary frame movable about the main axle, and constituting the support of the excavating wheel, and of the earth conveyors, for adjusting the wheel to the required depth of excavation, and causing the conveyors to conform to each new position of the wheel."

111. For an *Improvement in Revolving Fire Arms*; Eben T. Star, City of N. Y.

Claim.—"Mounting the series of barrels on a central rotating spindle or arbor, provided with a breech plate, so that it can slide thereon, to be moved forward to receive the charges, and then pushed back and locked, to inclose the charge. Also, the method of elevating the cock, by the finger lever, until it is engaged and held by a spring catch in combination with the trigger, so arranged that it can be operated by the continued pull of the finger lever, to effect the discharge. Also, in combination with the finger lever and trigger, the employment of the shifting stop on the finger lever, so that it can be set, either to effect the discharge by the continued back pull on the finger lever, or by touching the trigger with the finger after the cock has been elevated."

112. For an *Improvement in Platform Scales*; Francis M. Strong and Thomas Ross, Vergennes, Vermont.

Claim.—"1st, The use of corresponding concavities and balls, in combination with the proximate face of the intermediate bearing pieces and the shoe. 2d, The adjustable bearings, in combination with the pivots. 3d, The combination of the projections on the bearings, with the notches in the pivots."

113. For an *Improvement in Yarn Dressing Frames*; Abner J. Sutherland, Lowell, Massachusetts.

Claim.—"The use and application of a lever, or its equivalent, one end of which presses on the surface of the yarn wound about the beam, and to the other end of which the friction spring is attached. Also, my let-off motion, only as applied to dressers and similar machines, excepting looms."

114. For an *Improvement in Machinery for Felting Hats*; James S. Taylor, Danbury, Connecticut.

Claim.—"The combination of machinery, for the purpose of giving the hat a rotary longitudinal and vibratory motion at one and the same time; thereby subjecting the hats, as they pass along the chamber between the rollers, to a kind of rubbing or friction, similar to the rubbing performed by hand, and therefore causing the hats to be felted in a more perfect and expeditious manner, than by the combination of any machinery ever before used."

115. For an *Improved Box for Coating Daguerreotype Plates*; Joseph H. Tompkins, Buffalo, New York.

Claim.—"The construction and use, in combination with the common coating box of the jar, with the porous diaphragm and the orifice, in connexion with the tube and flask, together with the compress and its application, for the purpose of impregnating the lime or any other substance for retaining chemical vapors in the coating box, with the vapor of bromine—and for the further purpose of continuously furnishing the chambers of the coating box with a more regular, uniform and consistent supply of the vapor of bromine, or any other sensitizing chemical."

116. For an *Improvement in Curtain Fixtures*; Lewis White, Hartford, Conn.

Claim.—"The lever pawl, in combination with the ratchet and cord, so constructed

and arranged, that by pulling the cord (which operates the roller to wind the curtain,) in different directions, or different angles, it will vibrate the lever pawl so as to hold or release the ratchet."

117. For an *Improvement in Oscillating Engines*; Hugh Wightman and William Warden, Alleghany, Pennsylvania.

Claim.—"The arrangement of the plummer block, in correspondence with the steam openings of the hollow trunnion of an oscillating steam engine, and the steam openings of a suitable valve, so that the plummer block lies contiguously between the trunnion and the valve, and furnishes more or less a seat, respectively, for the trunnion and the valve."

118. For an *Improvement in Means for Regulating and Working Steam Valves as Cut-offs*; Charles H. Brown and Charles Burleigh, Assignors to the "Putnam Machine Co.," Fitchburgh, Massachusetts.

Claim.—"Operating the valves by means of the revolving cams, in combination with the bent levers, and their combination with the governor."

119. For a *Lathe Machine*; John L. Brown, Assignor to self and Charles Learned, Indianapolis, Indiana.

Claim.—"The vertical guide frame, in combination with the adjustable reciprocating rest."

120. For an *Improvement in Grain and Grass Harvesters*; Gelston Sanford, and Thomas and Stephen Hull, Poughkeepsie, N. Y.

Claim.—"Placing or hanging the axis of the driving wheel in circular bearings, which are allowed to turn in eyes, or straps attached to the frame—the axis being placed eccentrically, or out of centre in the bearings."

121. For an *Improvement in Hanging Mill Stones*; David Marsh, Bridgeport, Conn., Assignor to Thomas B. Stout, New Jersey, Joseph A. Cody, Ohio, and David Marsh, Connecticut.

Claim.—"The mode of securing the carrier of the spindle, by means of the vibrating feather inserted in the spindle; it admitting of being secured by keying in a recess in the cup."

122. For an *Improvement in Hydro-Carbon Vapor Apparatus*; Ari and Asahel Davis, Lowell, Mass., and Charles Cunningham, Nashua, N. H., Assignors to Alfred W. Adams, Lowell, Mass., Josiah B. Richardson and George W. Pettes, Boston, Mass., and Sherburne T. Sanborn, Winchester, Mass.

Claim.—"Employing the heat set free by the generation of the hydrogen, to heat the hydro-carbon used to impregnate the nascent gas."

Action in the Case of Interfering Patents.

To the Editor of the Journal of the Franklin Institute.

DEAR SIR:—The accompanying papers will, no doubt, prove interesting to many of the readers of your *Journal*, and especially to those who are concerned in patents.

Two patents for exactly similar inventions relating to grate bars were granted, one to Samuel Vansyckel, October 31st, 1854, and the other to J. C. Schlough, May 3d, 1855.

The following argument in favor of Schlough's claim, will give your readers an historical sketch of the entire case, and the decision of the Commissioner will serve to prove that the rights of real inventors are more efficiently protected than is generally supposed. As a preface, I forward the claims, illustrated with sketches of the three patents alluded to in the following papers.

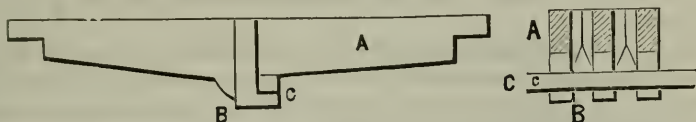
I am, Sir,

Respectfully, yours,

HENRY HOWSON.

Samuel Vansyckel's Patent, dated August 23d, 1853.

The nature of this invention consists in casting, or otherwise securing to the under sides of grate bars, hooks or catches, through which a rod or bar is passed and held, and by which the grate bars are prevented from warping or twisting by the heat, or from falling down if one end should slip off. A is the grate bar, B the catch or hook, C the bar.



Claim.—The construction of the above described grate bar as set forth.

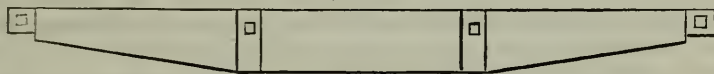
Samuel Vansyckel's Patent, dated October 31st, 1854.

Claim.—The casting or forming of the pin, dowel, or catch in one bar or set, with a corresponding hole or its equivalent in the next bar or set, so that when put together, they shall be held from warping, twisting, or dropping from the end plates or walls, substantially as described.

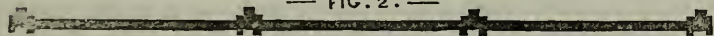
J. C. Schlough's Patent, dated May 3d, 1855.

Claim.—The mode of constructing grate bars for furnaces, with any convenient number of square or oblong tenons on one side, and a corres-

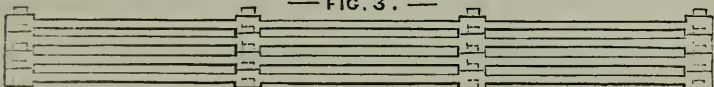
— FIG. 1. —



— FIG. 2. —



— FIG. 3. —



ponding number of similarly shaped mortises on the opposite side, substantially in the manner described, and for the purpose specified.

*Interference between Jacob C. Schlough and Samuel Vansyckel.**H. Howson's Argument in favor of the Claims of Schlough.*

To the Commissioner of Patents.

SIR:—The applicant in this case is foreman in Templin's foundry, at Easton, Pa., having occupied that situation for a number of years.

Samuel Vansyckel, with one of whose patents Schlough's application has been declared to interfere, at present resides at New York, but was formerly engaged in the distilling business at Little York, New Jersey.

On the 23d of August, 1853, a patent was granted to Vansyckel for improvements in grate bars, represented in the specification as "having

a hook or catch underneath, through which a rod or bar is passed and held, by which the bars are prevented from warping or twisting by the heat."

These bars are generally known in the neighborhood of Easton, as the Vansyckel hooked bars, and this is the title given to them by the witnesses in their depositions taken on behalf of Schlough.

It appears that a number of these bars were cast at Templin's foundry, Easton, to the order of Vansyckel, both before and after the granting of his patent.

One set of Vansyckel's hooked bars, in particular, were used at Thompson's distillery near Easton, and from the evidence of Smith and McCauley, the fireman and engineer of that establishment, it is certain that considerable difficulties attended their adoption.

Schlough, as foreman in the foundry where Vansyckel had his hooked bars cast, was in the habit of superintending the men who put the bars in their places, and was consequently familiar with their construction, as well as with their defects, and naturally enough his thoughts were directed to supply a means of overcoming these defects.

Early in the Spring of 1854, Schlough hit upon the simple and efficacious plan of casting grate bars with a tenon on one side, and a corresponding mortise on the opposite side, so that a set of bars when thus placed together with the tenons fitting into the mortises, would maintain an uniform level, and would be prevented from warping and twisting when heated; an invention which evinces the results of the well directed thoughts of a practical mechanic.

Schlough by this inexpensive arrangement, obtained the same desirable ends as Vansyckel with his hooked bars, unattended, however, with any of the difficulties to be met with in the latter invention.

The exact date of Schlough's invention does not appear; we have, however, the positive testimony of J. Eyerman, that a model had been made and exhibited to him on the 5th or 6th of April, 1854. Schlough's invention had, therefore, assumed a practical and patentable form at that date.

About the same time, models of the mortise and tenon bars were shown to James Thompson, of Easton, who says, in his evidence, that approving of the plan, he ordered a set of full sized bars to be cast, in order to replace a set of the Vansyckel hooked bars, which had not answered the purpose well.

Now, this set of mortise and tenon bars *were* cast for Mr. Thompson at Templin's foundry, under the direction of Schlough, and were finished on the 20th of April, 1854. Young, who was at the time clerk in Templin's foundry, is positive as to this fact; he says, "They (the bars) were charged in my handwriting, the 20th of April; I suppose they were delivered on that date; I never entered any thing in this book that was not delivered." (Book produced.)

We now come to the receiving of these castings by James Thompson, who says, "We carted them away on the 20th of April, 1854; I have a memorandum book. In that book there is an entry that the bars were received on that date." (Book produced.)

It was usual at Thompson's distillery to replace the grate bars under-

neath the boilers on a Sunday, in order that the regular routine of work should not be interrupted during the remainder of the week.

Smith and McCauley, one the fireman, the other the engineer of the establishment, both swear distinctly to the fact, that the set of Schlough's mortise and tenon bars were put in their places on the Sunday following their delivery; and that they were in use with fire on them, on the Monday following, which was the 22d of April.

It is thus plainly evident, that Schlough had his invention reduced to a practical form on the 6th of April, 1854; that he had a set of full sized mortise and tenon bars cast and delivered on the 20th of April; and that, on the 22d of the same month, the bars were in actual use at Thompson's distillery.

Now, it appears from the testimony of Barnett, Young, and Hackett, that Vansyckel frequently visited Templin's foundry at Easton, on business relating to his patent hooked bars; it is also shown that he saw the pattern of Schlough's mortise and tenon bars, as prepared for Thompson's distillery.

James Hackett, the man who prepared the pattern, says, "He (Vansyckel) usually conversed with me on such occasions (during his visits). He saw a pattern of Schlough's mortise and tenon bar, which I think was for Mr. Thompson; he said that Jacob's bar, alluding to Schlough's, would suit for small furnaces, but not so well as his own hooked bars for larger furnaces.

From this significant remark, we may infer that Vansyckel had no intention of claiming the mortise and tenon bar as his own invention at that date.

In a subsequent conversation with Barnett, however, Vansyckel objected to the mortise and tenon bar, on the ground that it was the invention of a man in Louisiana (Armstrong), when books of reference had been produced, and examined, and it was discovered that the invention in question was in no respect similar to Schlough's; Vansyckel remarked "*in a casual manner*," says the witness, that he had *thought* of that too, alluding to the mortise and tenon. And it is quite possible that he may have *thought* of it. What inventor is there who on looking over a list of patents, does not repeatedly find some invention he had *thought* of before?

It has been now shown that Vansyckel had every opportunity of gaining information of Schlough's proceedings, information he did not fail eventually to turn to advantageous account.

On the 19th of June, 1854, not having the least intimation of Vansyckel's intention, Schlough applied for a patent; he is informed by your officer Vansyckel had applied for a patent for the same thing, on the 19th of May, just one month before.

An interference being declared, the depositions of seven witnesses for Schlough were taken at Easton, before Charles Buch, Esq., August 1st, 1854. Through inadvertence, however, witnesses to prove the fact of Schlough's mortise and tenon bars having been in operation before Vansyckel made his application were not called, a deficiency which the testimony adduced on behalf of Schlough for the present hearing amply supplies.

On the 10th of August, 1854, the depositions of two witnesses were taken for Vansyckel at New York ; Schlough, and his then attorney, Mr. Green, being in attendance.

In your decision dated Sept. 13, priority is awarded to Vansyckel. It was Schlough's intention to appeal from this decision. Through the sickness of his agent at Washington, however, and the fact of Schlough being misinformed about the matter, the time for appealing elapsed, leaving him no other course but that of withdrawing his old application and filing a new one. This was accordingly done, and a notice dated January 30th, 1855, was received from your office, stating that Schlough's application had been adjudged to interfere with a patent granted to Vansyckel, Aug. 23d, 1853, that is, with the invention known as Vansyckel's *hooked bars*.

Thinking that a mistake had occurred in confounding one of Vansyckel's patents with the other, I, as agent for Schlough, requested you to rectify the matter, which was immediately done, by sending a second notice, dated Feb. 3d, which stated that "the patent of Vansyckel with which Schlough's application interfered, was ordered to issue Oct. 16, 1854, and not Aug. 23d, 1853, thus setting the matter right."

On the 19th of March, 1855, I examined at the office of Charles Buch, Esq., Easton, the following witnesses: Young, Barnett, Eyerman, Hackett, Thompson, McCauley, and Smith. During the entire proceedings Vansyckel was present, accompanied by his attorney, who took notes, but declined in every instance to cross-examine.

As Schlough up to this time has received no notice of the hearing of witnesses on Vansyckel's behalf, and as the general hearing at the Patent Office is appointed to take place on the first Monday (the 7th of May), it has been deemed advisable to make out the present argument without further delay.

Vansyckel having virtually declined to notify Schlough, it is reasonable to infer that he intends to rest his case on the testimony adduced on his behalf for a previous hearing at New York, on the 10th of August, 1854.

The witnesses in this instance were William Vansyckel, a brother and partner of Samuel and William ; Voorhies, a man in their employment. Both these men say, that in the month of March, 1853, Vansyckel made on pieces of paper, sketches illustrating a grate bar with mortise and tenons ; sketches, which were afterwards swept away as waste paper, and consequently lost. They also say that *no formal drawing* was ever made.

Now, as to these sketches, there is no evidence to show that they were any more than mere crude hints casually thrown out; the very fact of sweeping them away shows the value at which they as well as the ideas they were supposed to represent were estimated. Had the sketches been preserved and produced, then there would have been some tangible information as to how far the conception had progressed towards an invention. In the absence of the sketches, it may naturally be inferred from the evidence, that the whole substance of Vansyckel's so-called invention in March, 1853, consisted of *a gossiping conversation between himself and his two witnesses, enlivened by sundry scribblings on scraps of waste paper*.

In support of this position, I would respectfully direct your attention

to the evidence of William Vansyckel. After stating in his examination that he had a perfect recollection of the sketches as illustrating mortises and tenons, he says under cross-examination, "*I can't tell whether the mortises and tenons extended into the side of the bar.*"

Could anything be more contradictory than this? The sketches must have been vague and obscure indeed, if they did not show whether the mortises and tenons extended into the side of the bar or not.

Both of Vansyckel's witnesses lay great stress on the fact, that he did not apply for a patent for the mortise and tenon bars, because he thought that it interfered with Armstrong's patent.

Now, Voorhies says, that Vansyckel showed him a letter describing Armstrong's patent, in the same month of March, 1853. Did this letter convince him (Vansyckel) that there was an infringement on Armstrong? If it did so convince him *then* that there *was* an infringement, surely the same conviction would have been as forcible *in May*, 1854, when he saw Schlough's pattern, as it was in March, 1853, and the reason why he should not apply for a patent (as derived from this mysterious letter), must have been just as strong at one time as the other.

If, on the contrary, this letter *did* convince him that there was no infringement, why did he not secure at once an invention so simple, inexpensive, and efficacious, as the mortise and tenon bar, which common sense must have shown him to be infinitely superior to the clumsy, costly, and imperfect hooked bar. The very fact of Vansyckel patenting his hooked bar in Aug., 1853, serves to sustain my former assertion as to the vagueness of the sketches, and to show that the undeveloped idea of mortises and tenons (if he ever had such an idea), was but of trifling consideration in Vansyckel's mind, compared with his hooked bars.

As for the letter from Washington upon which such stress is laid by the witnesses, and which they assert to have served as a guide for Vansyckel, the simple question is, *why was not that letter produced as evidence?* Why did not his attorney produce Vansyckel's correspondence with his agent at Washington on the subject?

John Eyerman says, "I am on intimate terms with Vansyckel; we have frequently talked on the subject of grate bars. *I never heard* Vansyckel in any of these conversations mention the subject of mortises and tenons in connexion with grate bars." Hackett says substantially the same. In fact, from the time of making the sketches, up to the time Vansyckel saw the full sized bar of Schlough's, he never made the slightest effort to secure a patent for the mortises and tenons.

The very first glimpse, however, of Schlough's bar, seemed to have convinced him of its superiority, and of the effect it would have upon the sale of his hooked bars, if Schlough's were once introduced into the market.

This, no doubt, induced Vansyckel to make application for a patent, resting his chances of procuring the same in case of opposition, on the obscure sketches said to have been made and lost fifteen months before.

Now, I would respectfully ask, ought these vague and undeveloped sketches on bits of scrap paper, which cannot be produced and sworn to, only by men whose position in regard to Vansyckel, must naturally tend to bias their minds in his favor, to have any weight against the well

matured, practical, and valuable invention of Schlough, an invention of which the testimony I have laid before you, testimony of respectable and unbiased witnesses, gives a succinct and truthful history.

Numerous authorities might be quoted showing why this should not be, and nothing bears more forcibly on this subject than section 7, in the rules and directions issued from your office, where it says, "Merely conceiving the idea of an improvement or machine, is not such an invention or discovery as above contemplated. The invention must have been reduced to a practical form, either by the construction of the machine itself, or of a model thereof, or at least by making a full drawing of it, before it will prevent a subsequent inventor from obtaining a patent."

With none of the above directions had Vansyckel complied.

More than this, at a recent date and since the granting of his patent, Vansyckel has endeavored to procure castings of Schlough's bars from Templin's foundry for samples, as fully proved by Barnett's testimony, and by the letter put in as evidence, a fact which goes far to prove that even at the present time Vansyckel is unacquainted with the practical bearings of the bars in question.

It would be a hardship, indeed, if Vansyckel was allowed to reap the benefit of an invention of which he had not sense enough to see the superior advantages in the first instance, and which he was not mechanic enough to reduce to a practical result afterwards.

Schlough, therefore, as having put his invention into a practical form on the 6th of April, 1854, as having a set of bars in actual operation on the 22d of April, while Vansyckel did not make an application until the 19th of May; prays that a patent may be granted to him under the act of 1836, section 8, which empowers you as Commissioner (although a patent has been already granted to Vansyckel), to grant one to him (Schlough) likewise, and thus place both on an equal footing before the courts and the public.

I am, Sir, very respectfully, yours,

HENRY HOWSON, Agent for J. C. Schlough.

Interference between	} Grate Bars.
Jacob C. Schlough,	
& Samuel Vansyckel.	

It seems that nearly a year since an interference was declared between these parties in relation to substantially the same subject matter. Priority of invention was awarded to Vansyckel; no appeal was taken, and the patent was accordingly issued. In January following, Schlough filed a new application, and a new interference was declared. Vansyckel has taken no testimony, relying on the previous trial and decision. Schlough has taken testimony, showing that his invention was substantially made prior to the filing of Vansyckel's application in this case. I think in the present condition of this case, it would be improper to take into consideration either the testimony given in the previous case or the decision then made. This is a new case, and must be decided by the testimony now produced. There is nothing to show sufficiently that there was a previous interference covering this same ground. But laying aside any technical objection of this kind, and admitting that the previous interference was for precisely the same subject matter as the present, I should not feel jus-

tified in considering this as *res-judicata* in the same manner as a decision in a trial at law is conclusive on the same subject when a second time put in controversy.

The reason is not the same. In the one case, full opportunity is given to each party to obtain full testimony, and it is presumed to be his fault if he does not present his case fully to the tribunal which is to adjudicate. In the other there is no means of *obtaining* testimony, except it be voluntarily given. Ample opportunity for obtaining justice is not provided, and the party has frequently no means of securing his just rights but by filing a new application. The law does not seem to contemplate that one adjudication shall be conclusive in relation to all subsequent trials, but that whenever an interference is declared, the Commissioner will satisfy himself which of the parties is the prior inventor; and after he has made his decision, an appeal lies to the Judge of the Circuit Court. Now, the decision of the Commissioner, should be governed by the same rules as will control the Judge on appeal, so that the decision, if made correctly by him, shall be affirmed by the Judge.

Suppose, then, in the present state of this case, priority were to be awarded to Vansyckel, and there should be an appeal taken to the Judge of the Circuit Court; can there be the least doubt of his reversing the decision, inasmuch as he would have no evidence whatever before him on which to sustain the decision awarding priority to Vansyckel. I am therefore, of the opinion, that priority must be awarded to Schlough, which is accordingly done.

Patent Office, May 15, 1855.

C. MASON, *Commissioner.*

MECHANICS, PHYSICS, AND CHEMISTRY.

Note on various Phenomena of Oxygenation. By F. KUHLMANN.*

New Process of Formation of Sulphuric Acid.—It is well known that many hydrocarbons become resinified by contact with the air, in consequence of an absorption of oxygen. This is the case with most of the essential oils, and the drying oils undergo analogous modifications by a slow acidification; but it has not been suspected that these hydrocarbons, before undergoing any considerable modification in their constitution and properties, form, as it were, a provision of oxygen under such conditions, that when they come in contact with bodies which have the property of more immediately forming an intimate combination with oxygen, they yield the absorbed oxygen to the latter, and again acquire their original state, becoming again capable of attracting oxygen from the air. In these cases the resinifiable essential oils constitute sources of oxygen for the benefit of other bodies, and to a certain extent play the part taken by deutoxide of nitrogen in the manufacture of sulphuric acid.

When oil of turpentine is exposed to the air for a few days, and then agitated with a solution of sulphurous acid in water, the mixture becomes strongly heated, the temperature rises to 122° F., and even higher, and the sulphurous odor soon disappears, leaving only that of the tur-

*From the Lond. Chem. Gaz., No. 314.

pentine. In this reaction, which appears to be facilitated by the solar radiation, formation of sulphuric acid takes place at the expense of the oxygen absorbed by the turpentine, which is taken from it by the sulphuric acid before it has time to appropriate it in a more permanent manner.

If sulphurous acid gas be passed into a moist glass globe containing the vapor of an oxygenated essential oil, the sulphurous acid disappears by degrees; on the other hand, if a mixture of an aqueous solution of sulphurous acid and an aërated essential oil be allowed to become concentrated in contact with the air, the sulphuric acid formed carbonizes the essential oil without the necessity of raising the temperature of the mixture.

The oxygenating action of the aërated essential oil is not confined to sulphurous acid; it extends also to other acids, such as hyposulphurous acid, the sulphites, arsenious acid, &c.

Peculiar Reactions of the Essential Oils in Painting.—The essential oils, from the nature of their constituent principles, may be regarded as possessing naturally, and especially under the influence of heat or of the sun, a redutive power which acts slowly upon white lead and the colored oxides. However this may be, the resinifiable essential oils temporarily possess another property of an opposite nature, as I have just shown; and this deserves to be taken into consideration in the study of the modifications undergone by paintings in oil, namely, that of absorbing oxygen by mere contact with the air. The result of this is, that at the moment of their employment the essential oils may exercise an oxidizing action, tending to destroy vegetable colors and to modify some mineral colors. Thus:

Litharge, heated with aërated oil of turpentine, furnishes the puce-colored oxide of lead.

If oil of turpentine be agitated at the ordinary temperature with the hydrated protoxides of iron, tin, and manganese, these oxides pass to a higher degree of oxidation. With a solution of protosulphate of iron, basic sesquisulphate is produced, which separates from the liquid. The white precipitate formed by ferrocyanide of potassium with a protosalt of iron immediately acquires the intense color of prussian blue.

Blue and red flowers, decolorized by sulphurous acid, re-acquire their colors by contact with the aërated essential oil. The essential oil, freshly distilled, possesses no oxidizing power.

In the association of colors applicable to painting in oil, regard must therefore be had not only to the modifications which may be produced upon certain colors by the various mutual reactions of the coloring matters, but also to the oxidizing action of the essential oil, which must be manifested at the first moment of its application in the form of varnish.

General Considerations.—In all the reactions just referred to, the oil of turpentine, and in general the essences which are capable of absorbing oxygen from the air, behave as oxidants, the energy of which is sufficiently marked by the great elevation of temperature produced by the contact of the aërated essential oil with a solution of sulphurous acid.

It is important to ascertain whether this oxidizing property belongs to certain oils, and whether the proof of this fact may not account for the frequent spontaneous combustion of oiled tissues. Considerable interest

also attaches to the investigation of the action of the vapors of essential oils upon putrid miasmata, and the determination of the question whether, in these cases, there is not a combustion of the principles diffused in the air.

If oxygen can thus dissolve in certain liquids without combining, we are led to suppose that where it is disengaged it exerts its action upon the bodies with which it is in contact in the dissolved state before becoming gaseous. Are not the same circumstances presented in all the chemical reactions in which in our explanations we have recourse to the intervention of nascent gases?

Thus we shall be led to inquire whether other bodies do not share with certain essences in the power of forming a provision of oxygen, and yielding this reagent to assist in various reactions. This study may throw great light upon the phenomena of animal and vegetable physiology. The solution of oxygen in the blood by the act of respiration, and its subsequent assimilation, already present a great analogy to the phenomena which have just been described. As a question of health, it would be advisable to ascertain what may be the consequences of the respiration of air charged with essential oil in apartments newly varnished. On the other hand, we know how unfit water which has not been aerated is for good alimentation.—*Comptes Rendus*, Sept. 24, 1855, p. 470.

Remarks on the Smoke Question. By C. W. WILLIAMS.*

To the Editor of the *Mechanics' Magazine*.

(Continued from page 69.)

Conclusion 7. "That successful modes of preventing smoke, if there be proper boiler surface, may be adopted without the infringement of any patent right, the methods in question not having been patented, or the patents having expired."

With the exception of the words "if there be proper boiler surface," this conclusion is correct. It is true there have been numerous patents and contrivances for effecting the *consumption of smoke*, all of which necessarily were failures, as smoke cannot be consumed. There is, however, one mode, and one only, for effecting the *combustion of the gas*, whether generated in the furnace or the retort, namely, the bringing it into immediate contact with the proper quantity of air in the proper manner. This mode was patented by me in 1839. That patent being now expired, it has been introduced (but without acknowledgment) into many new patents; among these may be mentioned Woodcock's, Prideaux's, Parker's, and many others.

Conclusion 8. "That notwithstanding the obvious advantages of perfecting the combustion of fuel, such is the *indisposition of practical men to depart from the beaten track*, that nothing but the *force of law* is likely to ensure the care and attention necessary to protect the public, &c."

Nothing can be more correct than this conclusion. This "indisposition of practical men" arises from what Mr. Houldsworth (see his letter at

* From the *Mechanics' Magazine*, July, 1855.

page 16 of the Report of the Board of Health) considers as the "ignorance and prejudice" of the owners of furnaces. Ignorance of the principles which govern the laws of combustion, and prejudice, the accompaniment of such ignorance.

Manufacturers, and practical men in general, by neglecting to obtain the requisite information (perhaps because it involves something of chemical details), become thus dependent on others, and are ever at the mercy of their own servants and stokers, who have no interest to satisfy beyond that of saving their own labor. Whatever interferes with the easiest and laziest mode of managing a furnace, is sure to be condemned by the stoker, his employer being unable to detect the imposition. Now, the charging and managing a furnace, or of introducing the air, by which alone combustion can be effected, is as undeniably a part of *practical chemistry* as any of those numerous and minute details which fill the useful volume of "Faraday's Manipulations."

Conclusion. 9. "That though the absolute prohibition of smoke could not be enforced without compelling most of the owners of furnaces to incur very heavy expenses, its reduction to a very small amount may be effected with comparative ease, &c."

The conclusion with reference to the incurring "very heavy expenses," is here gratuitous and unwarranted. In truth, and speaking the result of great experience, it may be stated that the having "incurred very heavy expenses" is demonstrative evidence that the patentee of the invention applied was either ignorant of the simple process of nature in effecting combustion, and the facility with which that process can be carried out, or that the application of such costly or complicated apparatus as should involve "very heavy expenses," was mainly intended to give a color to or justify a high and commensurate charge and profit to the patentee.

Conclusion 10. "That the enforcement of smoke regulations can be most easily and quickly effected by the appointment of constables to keep a regular and constant watch upon all chimneys liable to emit much smoke; and that the prevention of smoke will be more quickly and certainly effected by *constant supervision and immediate information* of any breach of the regulations, than by heavy penalties irregularly imposed."

This is the soundest and most practically useful of the twelve conclusions to which the Board of Health have arrived. The appointment of "constables to keep a constant watch," is absolutely essential to the enforcement of regulations; while "*constant supervision and information*" are the only effective checks on that neglect and recurrence of mismanagement by which the evil would be continued. The authorities of Liverpool have wisely, though tardily, adopted this principle. They have appointed an official "*inspector of smoke nuisances.*" The result of even a few weeks of such supervision and "gentle legislative pressure," as Mr. Houldsworth expresses it, is too remarkable and undeniable to be questioned. On this head, and after many years of extensive practice, I can certify to the necessity of this constant and watchful supervision; nothing having thrown more difficulty in my way than the interested obstinacy of engineers and firemen, in adhering to their own lazy mode of

managing the furnaces, even of those employed in the numerous steam vessels under my own control. When to this is added the "indisposition of practical men" (the makers of boilers and furnaces) to depart from the beaten track, it can no longer be a matter of surprise that so little has been done in "perfecting the combustion of fuel." The mere stokers, and particularly in steam vessels, where they must necessarily be left to themselves, have it in their power to give apparent favorable results to their own modes and mismanagement, and plausibly to show them none other can supply the engine with the necessary quantity of pressure of steam.

Conclusion 11. "That great facility in the prevention of smoke would be afforded by the publications and descriptions of patented and other inventions for the prevention of smoke, by which those interested could be informed what they could and could not do in this matter, without infringing upon any patent right."

This is as impractical and useless a conclusion as the preceding one is practical and effective. Nothing, indeed, could be more certain of leading the public astray than the descriptions of even the patentees of their own respective plans. On this head more will be said hereafter.

Conclusion 12. "That great facility would also be afforded by the appointment of officers, specially qualified, and not connected with any patentee or manufacturer of boilers or furnaces, to superintend the police officers employed to suppress the nuisance of smoke, and to advise owners of furnaces how best to comply with the provisions of the law, and to report upon cases of its infringement."

This is a valuable suggestion. The difficulty, however, of carrying it out would, it is feared, be too great to render it generally available. The magistrate, in the discharge of his duty, is often unequal to the task of even appreciating the worth or truthfulness of the statements of the offending party; much less is he capable of offering advice, or suggesting a remedy, whether chemical or practical. The Admiralty Judge finds it necessary to have nautical men, as aids, or assessors, before he is qualified to decide on nautical distinctions. The civil judge, on the trial of offences in smoke-nuisance cases, should, in like manner, have an assessor; but he should be a chemical professor, seeing that the offence is as attributable to a breach of chemical laws or practice, as much as the improper steering a ship or mismanagement of sails would be a breach of nautical law or practice. Under the existing law, however, the magistrate is not called on for such strictly professional knowledge. With your permission, Sir, I propose hereafter to examine the general bearing and details of this important communication from the General Board of Health.

For the Journal of the Franklin Institute.

Electro-Chemical Engraving. By M. G. DERINCENZI.

The author has been for some years employed in a series of researches on the art of printing and reproducing designs by engravings in relief, and by printing type. The following is a description of his method.

The best metal for this kind of engraving is zinc. It is employed in

thin sheets, which are grained with sifted sand, and the design is made upon them with lithographic ink and pen. When the design is finished, it is prepared as if for the lithographic press. For this purpose, the plate is plunged into a decoction of nut galls for a minute. It is washed in pure water and gummed with a weak solution of gum arabic. The plate is moistened with a sponge, the design touched with essence of turpentine, and a lithographic cylinder coated with a varnish, rolled over the surface. This varnish covers exactly all the lines made by the designer. The varnish should have the following qualities: 1st, of not altering the design. 2d, of adhering strongly to the plate. 3d, of not being attacked by the chemical agents used to engrave it. The varnish known in England as *Brunswick Black*, mixed with oil of lavender, is preferable to all others. It is composed of asphalt varnish, linseed oil boiled with litharge and turpentine. When the varnish is dry, the zinc plate is put in connexion with a plate of copper, at a distance of $\frac{1}{8}$ of an inch, and plunged into a solution of sulphate of zinc marking 15° , thus a voltaic couple is formed, and the sulphuric acid dissolves all the uncovered parts of the zinc. More or less depth is given to the engraving according to the nature of the design. Pencil drawings are generally engraved in four or five minutes, pen drawings in from seven to ten minutes. The sulphate of copper produces no alteration in the most delicate lines, and does not attack the varnish.

This mode of engraving may be applied to any other process by which a design is reproduced. The drawing may be made upon paper and transferred upon the plates. Impressions from lithographic stones, from copper, or steel, may be transferred. Graving tools may also be used, and as well upon the zinc as upon lithographic stones, for the purpose of producing a flat shade. This process is equally applicable to printing type. It is sufficient to have a page of a book transposed upon a plate of zinc to make a stereotype.

This mode of engraving will replace the ordinary stereotype. According to this method, a page of a book may be transposed, during the printing, upon thin sheets of zinc, and from these upon stouter sheets, for engraving whenever a reprint is desired. Hence arises a great economy in composition and paper, since it is not necessary to print large editions. A copy on thin sheets of zinc will not cost more than a copy on good paper.

In the same way a stereotype may be made of old books.—*Comptes Rendus de l'Academie des Sciences de Paris*, November, 1855.

On a New Coating for Walls. By M. CLAUDOT.

The author proposes to paint the walls with the milk of lime, which by absorption of carbonic acid from the air will form a permanent coating, and prevent the formation of lichens which stain and destroy the surfaces. He also suggests the same application as a species of enamel on mantels, clock-stands, and earthenware. (*Comptes Rendus de l'Academie des Sciences de Paris*, November, 1855.)

The process, is not new; it was suggested in this country many years ago; we believe, by Professor Emmet, of Baltimore. We have seen many

medals and statues in plaster of paris beautified and preserved by immersion in a solution of carbonate of soda, by which their surface is converted into crystalline carbonate of lime. Care should be taken that the solution contains no bi-carbonate or excess of carbonic acid, otherwise the coating will be dissolved.

ED.

TWENTY-FIFTH MEETING OF THE BRITISH ASSOCIATION FOR THE
ADVANCEMENT OF SCIENCE.*

On the Meteorology of the United States and Canada. By Mr. R. RUSSELL.—He first drew attention to the physical geography of North America, as influencing in a very particular manner the meteorological phenomena of that country. The Appalachian chain, from Northern Alabama to Maine, runs parallel with the Atlantic coast, and though only from 2000 to 4000 feet in elevation, exercised a marked influence in giving peculiar development to certain atmospheric disturbances which took place in the Atlantic States. To the west of this chain lies the vast valley of the Mississippi; its surface forms an easy ascent towards the Lakes of about one foot in a mile. This great basin is thus exposed to the free course of the south winds from the Gulf of Mexico. But the Rocky Mountains on the west, stretching from the Arctic Circle, appear to be the grand physical feature which in a great measure determines the peculiarities of the meteorology of North America. This range has an average elevation of 10,000 to 12,000 feet, which is almost unbroken to the Isthmus of Panama. This vast natural wall forms a barrier to the trade-winds of the Carribean Sea, as they cannot cross this ridge and flow into the Pacific. By means of this elevated land, which forms the isthmus connecting the two continents, the trade-wind is gradually directed northwards until it reaches Texas as a south wind, which is the prevailing one in that State throughout the year, but more especially in summer. The great fertility of the climate of the United States and Canada, is to be chiefly ascribed to this physical feature of the country. The flow of the south wind in winter brings moisture and mild weather—in summer intense heat, with thunder storms. The wind which is entirely opposite in its character to the south is the west. In winter, a due west wind is intensely cold over the whole territory of Canada and the United States, and it often blows with great violence: there is no relaxing of the cold weather so long as it continues. In summer it is dry, and the sky assumes that bright azure tint which is so striking to one from our island. It is a singular fact, that a west upper current flowing across the Rocky Mountains seems to prevail almost constantly during the whole year. This must never be lost sight of in discussing the atmospheric phenomena of North America. The upper current is nearly due west at Washington and the States to the south; it is a point or two north of west in the New England States and Canada. The west and north-west wind of the United States must be regarded as the descent of the upper current. In fact, the winds of the United States, especially during great atmospheric

*From the Lond. Athenæum, September, 1855.

disturbances, may all be considered to become modifications of the south and the west wind. The indications of the thermometer and hygrometer are entirely in favor of this arrangement. The N. and N.W. winds must be regarded as modifications of the upper westerly current descending to the surface of the ground, and the S.W., S.E., E., and even N.E., as modifications of the south wind. The difference betwixt the temperature of the Arctic current and the Gulf stream, as they meet beyond the Newfoundland coast, is not nearly so great as the difference of the temperature, in winter, between the west current which descends along the eastern slopes of the Rocky Mountains, and the south wind from the warm waters of the Gulf of Mexico. The vast territories of the United States to the east of the Rocky Mountains, are subjected alternately to these two currents, so opposite in their characters, and hence the great changeableness of the climate, to which we have nothing that can be compared in Europe. The exceeding coldness of the west wind arises from its being robbed of its moisture as it crosses the Rocky Mountains. It is specially worthy of being kept in mind, that the west wind, or its modifications, is light and pleasant in the warm season, but intensely cold in winter, and blows with great vehemence when it succeeds the south wind. After the west wind has blown for some time in winter, the whole area over which it has extended is subjected to a great depression of temperature. As a general rule, the temperature rises in the far west in winter for some time before it rises in the Atlantic States. The weather first moderates in the territory east of the Rocky Mountains and west of the Mississippi, by a south wind, 500 to 700 miles in breadth, setting in and blowing along the eastern slopes of the Rocky Mountains, and probably extending into the Arctic Circle. The rise of temperature thus takes place over all the region swept by the south wind. The rising of temperature is apparently propagated from west to east in the United States, by the south wind flowing in succession over those States which are more westerly. This is the cause of the winter storms of the United States traveling from west to east, as has been maintained by Prof. Espy, who was the first that made the discovery, and which has since been corroborated by Profs. Hare and Loomis. The distance between the ridge of the Rocky Mountains, and the east coast of Florida, is about 1400 miles, but in the latitude of Newfoundland, the Rocky Mountains are nearly double that distance from the Atlantic. The south wind never seems to occupy at one time the whole breadth of the country from western Texas to eastern Florida. The south wind is rapidly propagated from the west along the northern shores of the Gulf of Mexico, but it is almost as rapidly destroyed on its western edges by the cold upper current descending along the eastern slopes of the Rocky Mountains, and penetrating, as a surface wind, this warm current from the Carribean Sea. In this manner the western edges of the south wind are raised into the upper current, and drifted towards the east. Thus the winter storms of the United States are always succeeded by a cold wind from a westerly direction. The cause of the violence of the west wind in winter was then shown. The weather during summer was regulated by the same principles, but the north-west wind then lost its power, in consequence of its being warm and elastic. The thunder-storms and

tornadoes generally drifted from west to east in the Middle States, and from north-west in the Northern States. This arose from the clouds being formed in the upper current and drifted towards the east at the very time that the south wind was prevailing. The thunder and tornado clouds usually drifted in the south wind over the States bordering on the Gulf of Mexico. The hurricane-clouds also drifted in the southern stream of warm air, and were often propagated along the Atlantic coast. The fluctuations of the barometer were attributed to the fluctuations of density of the air at the surface of the earth. This was Daltier's hypothesis, which he thought explained the fluctuations of the barometer more consistently than any which had been offered. It did not explain all in Britain, but it explained a great deal,—the apparent exceptions were all grouped together very consistently. The height of the barometer was inversely as the temperature, or rather moisture, for the latter was a more permanent cause of high temperature. Diagrams were exhibited to illustrate this connexion between the rise or fall of temperature and the fall or rise of mercury. By adopting the arbitrary scale of 5° of heat as equal to 1-10th inch of mercury, which indicated the south wind to be about 10,000 feet in height, a great parallelism between the curve of temperature and inverted curve of the barometer was exhibited. A more perfect explanation of the fluctuations of the barometer at Alabama could not be given. The south wind being lighter, depressed the barometer at every place when the temperature was raised. The low barometer extended in a long line from the Gulf of Mexico to the Lakes, and traveled to the east as the rains and high temperature did. The grand exceptions to fluctuations of the barometer being occasioned by fluctuations in the density of the air at the surface of the earth, arose in the West Indian hurricane, when a depression of two inches was sometimes observed to take place. The only theory which successfully met this phenomena was that by Prof. Espy, in which the wind blowing towards a central space rose in consequence of the extrication of latent caloric, by the condensation of moisture through the expansion of the air causing a reduction of temperature below the dew point. Prof. Espy maintains that the whole force generated during hurricanes can be accounted for by the effects of heat,—Prof. Hare, that part is due to electrical agency. In the case of the sea-breeze, a considerable body of air is put and kept in motion by slight differences in the weights of adjoining columns of air. Were such differences of the atmospheric conditions as the chart of the 10th of November exhibited, between the mouth of the Mississippi and Montreal, tremendous disturbances would ensue. When the distance is great the power is diffused in moving the whole body of air betwixt the stations. The expenditure of power in this diffused manner may be compared to the flow of the Mississippi over the last 1400 miles of its course, where the fall is less than three inches to a mile. On the other hand, when the Niagara tumbles over its great precipice, it expends much power at once. The hurricane might be regarded as an aerial cataract, only the air being forced upwards. If a slight fall of rain produced such remarkable effects as are noticed on the passage of the squall-cloud, what must be the power evoked by the evolution of latent caloric in hurricanes! Six inches of

rain have been known to fall during some hurricanes. The caloric set free by the condensation of this amount of water over every square mile is equal to that which would be generated in the burning of 2,620,000 tons of coal, allowing 1 lb. of coal to evaporate 13 lbs. of water. The clouds of the hurricane interrupt the ominous calm as suddenly as the smooth flow of the stream is changed at the brink of the cascade. Prof. Espy has made this neglected department of meteorology the subject of most profound investigation. At the last meeting of the British Association in Glasgow, Prof. Espy attended and expounded his celebrated theory of tropical hurricanes. He would again have appeared before you at this visit, had not the fatigues of a voyage across the Atlantic in the evening of life deterred him from doing so. Mr. Russell said he had conveyed a request from him to Sir D. Brewster, to move for a committee of the British Association to inquire into the disturbing forces of the tropical hurricanes. Mr. Russell concluded by saying that he hoped it would be granted, as the present state of the science imperatively demanded it.

Notices of Rain-Falls for a Series of Years at Home and in Foreign Countries. By Mr. SYMMONDS.—After pointing out the advantages which would result from an accumulation of facts that would serve to guide us to a knowledge of the mean average fall of rain in certain periods—the proportionate evaporation, and the alternation of wet and dry seasons, Mr. Symmonds pointed out the value of such inquiries to the agriculturist, the physician, and the statistician; and showed how important was this knowledge of the mean annual fall of rain in particular localities, and the average number of days in which rain fell in the year. Particular crops, as the sugar-cane, the indigo plant, the cotton and tobacco plants, might be entirely ruined by too much or too little rain. Many localities, such as Malta, Gibraltar, Ascension, &c., are obliged to husband the rain-water in tanks. The navigation of rivers and the irrigation of adjacent lands are also dependent on a certain amount of rain. And the potato, the vine, and other plants are injuriously affected by the condition of the atmosphere and the superabundance of moisture. Even the fact of whether the moon has any influence on the fall of rain is still a disputed point. The relative proportions of rain that fall by night and by day was another point touched on. Mr. Symmonds then took a survey of the records of this branch of meteorology in the various quarters of the globe, citing the comparative falls of rain in the tropics and in temperate regions in various countries. The enumerations were perhaps the most full and complete that have ever been collected on this important subject.

Extracts from a Letter from the Rev. A. Farrar, of Queen's College, Oxford, on the late Eruption of Vesuvius—Were read by Dr. DAUBENY.—The writer stated that for a period of three years from 1847, the volcano exhibited symptoms of restlessness, &c., and on one occasion, December, 1849, sent out a small stream of lava, interesting from the fact of crystals occurring in it, analogous to those of the little stream of 1845. But in February, 1850, a violent eruption took place, from three craters, which formed on the south-east of the great cone, each above the other, in a vertical line from the summit to the foot. In fact, owing to the

abundance of lava, it might be almost said that a great fissure opened from the summit nearly to the Atno del Cavallo. The stream flowed along the Atno at a point a little to the north of the stream of 1834, and then turning south; when, pressed back by the ancient lava of Monte Somma, it flowed over the current of 1839 in the direction of Ottagaus and Bosco Reale, destroying much of the fine oak of the forest; the stream continuing to flow for three days. Such was the history until the present eruption, which might be said to have commenced last December by the sudden giving way of a portion of the cone of Vesuvius, at a distance of perhaps 100 yards north of the northern of the two craters formed by the eruption of 1850, and a very little distance below the level of the summit. This crater or hole, for it had never vomited anything but gas, still existed, though now piled up by débris to within a depth of 100 feet. Mr. Farrar felt a peculiar interest in this hole, from the hope—though one perhaps could hardly hope it at that height—that it would reveal the internal structure of the west cone, so as to throw light on the question of craters of elevation.

On Alloys of Iron and Aluminium. By Prof. CALVERT.—Messrs. Calvert and Johnson, of Manchester, have succeeded in preparing the following alloys of iron and potassium:—1st alloy: 4 equivalents of iron, 1 ditto of potassium. 2d alloy: 6 equivalents of iron, 1 ditto of potassium. These alloys were prepared with the view of solving one of the great chemical and commercial questions of the day—namely, that of rendering iron less oxidable when exposed to a damp atmosphere; as these gentlemen believe that no kind of coating can be discovered which will resist the constant friction of water, as is the case with iron steamers. They have also succeeded in producing two new alloys, composed of iron, combined with that most valuable and extraordinary metal, aluminium, lately obtained by M. St. Claire Deville. These two alloys are composed as follows:—1st, 1 equivalent of aluminium; 5 ditto of iron. 2d, 2 equivalents of aluminium; 3 ditto of iron. The last alloy presents the useful property of not oxidizing when exposed to a damp atmosphere, although it contains 75 per cent. of iron.

On the Titaniferous Iron of the Mersey Shore. By Dr. EDWARDS.—Dr. Edwards remarked upon a form of titaniferous iron which occurs on the western shore of the Mersey, and gave his analysis of it, by which it appears to contain 13.20 per cent. of titanacic acid, which is its most valuable constituent. It disintegrates from boulders found in the clay drift along the shore of Seacombe, and becomes mixed with the sand, from which it is separated by means of a magnet. It also contains alumina, silica, and magnetic oxide of iron; hence it possesses magnetic properties. The mineral does not belong to the series of rocks of the neighborhood of Liverpool, but exists in large masses, and has been carried by drift from the hills of Cumberland.

On the Action of Sulphurets on Metallic Silicates at high Temperatures. By D. FORBES.—This communication first treated of the sulphurets of metals formed by fusion, showing that very distinct compounds were thus formed generally more basic than under other circumstances. The action of sulphurets on silicates was illustrated by a series of researches, which showed that when the silicate of a weaker metal was fused along

with the sulphuret of a stronger one, or *vice versa*, the result was the same,—not a perfect mutual decomposition, as would have been expected, but the production of a double sulphur-salt of both metals. When the fusion, however, took place at lower temperatures no action was found to take place. A series of specimens illustrated the occurrence of such re-actions, metallurgical operations and their chemical composition, &c.

On a Process for obtaining and purifying Glycerine, and on some of its Applications. By Mr. G. F. WILSON.—The manner in which it is prepared is by placing a piece of common fat in a quantity of super-saturated steam; the fat is decomposed, and resolves itself into two substances, viz., as acid and glycerine. The latter having a taste like sugar—is applicable to the cure of burns, rheumatism, and ear diseases; it is a substitute for cod-liver oil, and also for spirits of wine; also for the preservation of flesh; and can be applied to photography, and preserving animals in their natural colors.

On the Composition of Bread. By Dr. MACLAGAN.—He gave the results of some experiments which he himself had made. The amount of moisture in bread was less, and consequently the nutritive value greater, than was generally allowed. The late Prof. Johnston had stated that a sack of flour produced one hundred quartern loaves. But, according to his (Dr. MacLagan's) examination, the sack of 380 lbs. gave 94½ loaves of bread; 100 lbs. of flour giving 231 lbs. of bread. The majority of bakers were of opinion that the sack produced, on an average, 92 loaves, and there was no great discrepancy between this and the result of his own analysis. Unfermented bread contains, of dry flour, 60; moisture, 10; water added by baker, 30. 100 lbs. of flour will give 143 lbs. of bread, and a sack of flour will yield 100½ quartern loaves of unfermented bread.

Baron LIEBIG made a few observations on a new mode of making bread introduced into Germany. Lime-water had been used in the preparation of the dough, and the loaf was rendered still more nutritive than that made by the common mode.—Dr. PLAYFAIR said the Section were much indebted to Dr. MacLagan for his communication. Much discrepancy existed among analytic chemists on the subject; but he believed Dr. MacLagan had arrived at pretty accurate conclusions.

For the Journal of the Franklin Institute.

Iron Ships.

The advantages attending the use of iron as a material for ship building are so many, that it is a matter of surprise, that up to the present time in this country, they have been almost entirely overlooked. We have on the Delaware a few steamboats where its merits have been appreciated, and the saving by reducing draft of water in consequence of less weight of hull, is of itself more than sufficient to counterbalance any increased first cost of construction. In addition to this, iron is more lasting. After ten years in a wooden ship, and half that time in a sea steamer, the frames, planking, etc., become so decayed, as to be a constant source of expense, and I am informed that our insurance offices consider eleven years as the *average* duration of timber built ships. We have but two iron vessels, that I am aware of, constructed for sea service—the coast

survey steamer, *Walker*, and the revenue cutter, *Polk*. These vessels have been in use for eight years, and a recent examination of the former vessel, when on the dock, did not exhibit any symptoms of decay beyond a very slight rust; the bottom plates appear as thick as when first put on, and, in fact, all that portion of the hull made of iron was in good condition, while the wooden decks and water-ways were very nearly worn out. In England the merits of iron are more fully understood, and a wooden vessel there is as rare as an iron one here. Many of the iron ship builders are those formerly engaged in timber built vessels, and in a few years the merchant ships of England will nearly all be of iron. It may be urged that iron is more costly and timber much cheaper here than there. This is true, but yet is not sufficient for the neglect on our part to examine into the matter more fully. Within the last five years the wages of ship carpenters (always in advance of those in England) have advanced. Ship timber of all kinds is worth more than then, and the price of good timber will be constantly advancing from its increasing scarcity, which has caused for years past the use of inferior material. Copper, which enters largely into the construction of timber built ships, has in that time advanced twelve cents a pound, or about 50 per cent. While this has been the case with the material used in timber built vessels, iron has, on the contrary, not advanced, and can, at the present time, be purchased at a price sufficiently low to enable vessels to be built at a price but little, if any, exceeding the cost of a *first class* timber built vessel. But admit that the iron vessel should cost ten or even twenty per cent. more than the wooden one, look at the advantages to be gained, viz:—

Increased capacity as to bulk of freight equal to 20 per cent., which, on a ship, carrying 5000 bales of cotton, would make a difference of 1000 bales, increasing freight money in the same proportion.

Safety at sea from not leaking, and when injured by collision, not sinking, the iron bulkheads preventing this, as in the *Vesta*, the ship that came in contact with the *Arctic*.

Durability.—An iron vessel will outlive three wooden ones. Twelve years make no impression on them—witness the account of the iron ship, *Richard Cobden*, that has been employed in the East India trade.

The following is taken from the *Liverpool Albion*, October, 1855—

“The iron ship, *Richard Cobden*, which was built at Liverpool twelve years ago, will repay a visit from any one interested in iron ships. She has been twelve years in the East India trade, and has not had the slightest repairs done to her; has never made a drop of water, and will, to all appearance, last to an unlimited length of time. This vessel has completely set aside the old notice of A 1, for twelve years.”

A timber built ship has a very great number of vertical and horizontal joints between the planks where there is no connexion, which are filled with oakum to prevent the vessel from leaking, and it is the starting of one of these at sea that causes many a ship to founder, and damages cargo to the amount of many hundred thousands of dollars annually; this is an evil inherent in wooden vessels, and nine out of ten suffer in some degree from it every voyage. An iron vessel, on the contrary, has not such a seam in her construction; every sheet is made to lap its neighbor, and they are firmly riveted together, making the vessel as one piece.

The introduction of iron ship building among us, would do much towards increasing the consumption of plate iron, one of the staple productions of our State, and, at the same time, it would give to the merchant a better and more *profitable* vessel. It is necessary, however, for some one to commence, and I hope that there is sufficient enterprise and money among us to do it. If the plate iron dealers themselves were to undertake it, they would be doing what would very soon give them a large increase of business, and, at the same time, making an investment that would be sure to yield them a liberal return. X. Y. Z.

NOTE. The only iron vessel at present building in this city, is a small steamer by Messrs. Merrick & Sons, at the foot of Reed Street, intended for Lake service.

For the Journal of the Franklin Institute.

Iron Ship Building.

Few persons are aware of the extent to which this business is carried on in England, and the following details of the two largest steamers at present afloat, which have been recently built, will no doubt be of interest to your readers.

First. The *Royal Charter*, built for the Australian trade; her length over all is 336 feet, breadth of beam 42 feet, depth of hold 26 feet 6 ins., registered burthen 2700 tons; independent of her steam power, she is a full rigged ship and spreads 15,000 yards of canvass. Her auxiliary steam power consists of two engines, with cylinders of 45 inches diameter, 2 feet 3 inches stroke. Propeller 14 feet diameter, 13 feet pitch; the propeller shaft is 130 feet long; the coal bunks will contain 425 tons, which is more than will be required for the time she will have to steam on her passage out. When under canvass, the screw is disconnected and hoisted out of the water, which requires but ten minutes. On her trial trip with a pressure of $13\frac{1}{4}$ lbs. of steam, the engines making 75 revolutions, she made an average speed of nine knots in smooth water.

Second. The *Persia*, built for the Cunard Line, and expected to exceed in speed any steamer at present afloat on the ocean. Her dimensions were given in the last number of the *Journal*, (page 66,) but the following details of her construction will show in what manner she is put together. The framing of the ship is very heavy. The space between each frame is only ten inches, and the powerful frames or ribs are themselves ten inches deep, with double angle irons (knees) at the outer and inner edges. The bow is constructed in a manner at once peculiar, and affording the greatest possible strength to this important part of the ship. The framing is so placed to the stern that the effect is that, in the case of collision with other ships, or with rocks, or icebergs, the strain would fall upon the strongest material within the structure, and the *Persia* would have a good chance of safety and successful resistance, while ordinary vessels would indeed be in great peril. She is not clinker-built, as some ships have been constructed of late. The plates, or outer planking of the ship, so to speak, are laid alternately, so that one adds strength to the other, and they form a whole of wonderful compactness and solidity. The keel-plates are $\frac{1}{16}$ ths of an inch in thickness; at the bottom of the ship the

plates are $\frac{1}{8}$ ths of an inch in thickness: from this section to the load water-line they are $\frac{3}{4}$ of an inch; and above this they are $\frac{1}{4}$ of an inch in thickness. The plates round the gunwale are $\frac{7}{8}$ of an inch in thickness. She has two engines, and eight tubular boilers, and two funnels; and we need only speak of her machinery in general, which is all ready, as being first-class. The firing space for the boilers is placed in the fore and aft line, instead of across the ship, as is usually the case with smaller vessels.

The weight of the iron in the *Persia*, when launched, was 2200 tons. When the engines are on board, and fully loaded, the weight of the immense mass will be 5400 tons, at which time she will draw 23 feet of water. Her coal cellars are constructed to receive 1400 tons of coal—an ample supply to carry her on her voyage across the Atlantic as fast as she can burn them. She has also accommodation for about 1200 tons measurement of goods.

On her trial trip from Govan to Liverpool, a distance of 175 knots or 203 miles, which she run in 10 hrs. 43 min., equal to 16 knots or 19 miles per hour, which was great speed, even if we allow that she was light, as was probably the case; she will no doubt be very fast, and test the Collins line, including the *Adriatic*, to their utmost. B.

On Measuring the Length of Connecting Rods of Steam Engines.

To the Editor of the Journal of the Franklin Institute.

SIR:—If you do not consider the following query an intrusion, an answer would oblige more than one of your *younger* readers in this vicinity.

In a direct action engine, why is the length of connecting rod taken as the distance from centre of cross-head pin to centre of *crank-shaft*, instead of *crank-pin*, when the crank is vertical, or, in beam engines, from main centre to the plane of crank-shaft centre, instead of from centre of pin in the beam, to centre of crank-pin?

Yours, respectfully,

Lowell, January 8, 1856.

T. W. S.

Reply.—In a direct acting engine, the length of the connecting rod is equal to the distance between the centre of the cross-head pin (when the piston is at half stroke) and the centre of the crank-shaft, for this reason:—As the throw of the centre line of the crank-pin, on each side of the shaft, is equal, it is evident, that the middle point of the crank-pin's complete throw or stroke, is coincident with the centre of the crank-shaft; and as, by supposition, the cross-head pin is in the middle point of its stroke, it follows that the distance between the centre of the cross-head pin and that of the crank-shaft is proper for the length of the connecting rod.

The distance from the centre of cross-head pin, at half stroke, to the centre of crank-pin, when the crank is at right angles to the centre line of the cylinder, would be too great, except in the supposititious case where the rod is of an infinite length. In all other cases, as the rod forms an angle less than 90° , with the line joining the centres of the crank-shaft and pin, when the crank is at right angles with the centre line of cylinder,

der, there would be an excess of length equal to the difference between the base and hypotenuse of a right angled triangle, in which the base AB , is formed by the line joining the centres of the cross-head pin and crank-shaft; the perpendicular, BC , by the centre line of the crank; and the hypotenuse, AC , by the centre line of the connecting rod: then, by the well known formula,

$$AB^2 + BC^2 = AC^2,$$

the excess can be found.

To get the length of connecting rods for beam engines, the following directions will be found on page 225 of the *Treatise on the Steam Engine*, edited by John Bourne:—"The length of the connecting rod is the distance from the centre of the beam when level, or the plane of the main centre, to the plane of the paddle shaft." This, though not strictly accurate, is perhaps near enough when the length of the beam is great compared with its stroke, but, in American river boat engines, the beam is comparatively short, in some instances, being only one and three-quarter times the stroke; consequently, the versed sine of the arc described by the end pin, in moving from the plane of the beam centre to the end of its stroke, is considerable, and affects the length of rod. The reasoning employed in the case of direct acting engines, to determine the centre of the shaft as one point from which to measure, applies as well to beam engines. Then, the length of the rod is equal to the distance between the centres of the crank-shaft and the end pin; for, if the plane of the beam be taken as a measuring point, the rod would be too short, because the length of the beam is such, that a vertical line drawn through the centre of the shaft bisects the versed sine of the arc described by the end pin, and, therefore, the deficiency in length would be equal to the difference between the base and hypotenuse of a right angled triangle, in which a vertical line passing through the centre of the crank-shaft would be the base AB , half the versed sine of the arc described by the end pin would be the perpendicular BC , and a line joining the centres of crank-shaft and end pin the hypotenuse AC ; from which, by the afore given formula, the length may be calculated.

*Consumption of Smoke.**

The following is a digest of the information with regard to the operations of inventions for the consumption of smoke, which has been elicited by the inquiries of the General Board of Health among persons who have employed inventions for this purpose, and forwarded to Viscount Palmerston by the General Board.

General Board of Health, Whitehall, July 20, 1854.

In accordance with the request of Viscount Palmerston, conveyed in Mr. Fitzroy's letter of the 31st day of October, 1853, the Board have instituted very extensive inquiries among those acquainted with the means for the prevention of smoke, a great part of the evidence thus received being given in abstract in the Appendix to this Report.

From the evidence thus obtained, it appears that smoke has been entirely prevented, in many cases, in that large class of furnaces used for

* From the Lond. Civ. Eng. and Arch. Jour., July, 1855.

boiling, as for steam engines, brewers' and dryers' pans, &c., without any alteration of the furnace, where it had in the first instance been well constructed and carefully attended to, and that it is easy very considerably to diminish the smoke commonly emitted from such furnaces without any extraordinary care, by alterations neither expensive nor troublesome, if the furnace is not very badly constructed.

It also appears, from this evidence, that in many such cases smoke has been prevented by good stoking *alone*, and by slightly opening the furnace door after putting on coal, and that smoke from all furnaces may be much more greatly diminished. If to good stoking be added one of the many contrivances for admitting air above or beyond the fuel, smoke may be very generally prevented, except when the fire is first lighted, and for short intervals after adding fresh fuel.

It also appears that where particular circumstances have rendered the prevention of smoke from bituminous coal difficult, many manufacturers have found it advantageous to resort to the use of smokeless fuel that produces no more smoke than can readily be consumed.

It also appears that smoke from almost all fires, such as those for warming rooms and cooking, for bakers' ovens and pottery kilns, may be very considerably diminished and in many cases entirely prevented, for that has been accomplished in several instances of each of the different kinds of fire.

Besides the information thus derived from a large number of persons interested in inventions for the prevention of smoke, the Board have also received returns from fifty-six firms which have adopted various means for the diminution of smoke. These returns refer to a far larger number of furnaces than fifty-six, as most of the firms in question use several furnaces. From this table it will be seen that in almost all these cases very considerable success has attended the efforts to reduce smoke. The reply to the question, "Have you succeeded in diminishing smoke?" has in twenty-three cases been simply "yes;" in eighteen other cases the answer is to the same effect, *e. g.* "almost entirely," "not more smoke than a private house," "completely, except when the fire is first lighted." Others seem to have been less completely successful, and make such replies to the question as "partially," "considerably," "yes, to some extent," &c. Three only of those to whom queries were addressed seem to have entirely failed.

After such instances of success it is impossible to deny that smoke may be prevented. Numerous cases indeed of partial and some of complete failure have occurred, but these only show that proper means have not been used, or that the means employed have not been adapted to the particular cases.

It has been commonly asserted that the requisite heat cannot be maintained without producing smoke; this difficulty has been experienced by only eight of the fifty-six firms which have sent returns. Some state that the difficulty has been slight, others, that increased heat has been occasioned in equal time with less fuel, and this, indeed, appears to be the usual result.

The effect upon the consumption of fuel has not been accurately observed, but in a large majority of cases a considerable saving has been

effected. In twelve only of the fifty-six has there been no saving; in three consumption has increased; in nine it is stated not to have been ascertained; in thirty-five the saving is variously estimated from five to fifty per cent. The explanation of this great disparity appears to be, that means for the prevention of smoke have often been accompanied by changes in the boiler, which may have been the chief cause of the saving. In other cases smoke has been prevented by admitting air in excess, which has carried off part or all of the additional heat produced by more perfect consumption.

The degree in which the prevention of smoke has been effected is also various. Unexceptionable experiments show that in some instances it has been all but perfect, while in these cases there has been at the same time a great saving of fuel. Mr. Houldsworth, of Manchester, for example, with Williams's Argand furnace, has obtained a saving of from ten to twenty-five per cent. and sometimes even from twenty-five to thirty-five per cent. A saving of one-half of the fuel now used might be obtained by altering some of the worst furnaces and boilers into the best.

Messrs. Dirk & Co., who state that the furnace for which they were agents (namely, Williams's expired patent of 1839), has been successfully introduced in above 2000 cases. This is one of the many plans, and perhaps the best, for admitting air beyond the fuel. It has been highly recommended, apparently justly, both for its scientific and practical merits.

G. F. Wilson, of Price's Patent Candle Company, reports that their company succeeded in preventing smoke by using anthracite coal with a fan, but when the supply of that coal became irregular and costly, they resorted with complete success to various patented processes. They now use Jukes's, Hall's, and Hazeldine's furnaces, three patented methods for carrying the coal slowly from the front to the back of the furnace. At Liverpool the company has fourteen furnaces of thirty-five horse power each, and nineteen at Vauxhall and Battersea, all, it is stated, giving perfect results.

"You will not wonder after the above," adds Mr. Wilson, "that it seems odd to us to hear of the impossibility of consuming smoke, and to see people so regardless of their pockets, sending good fuel up their chimneys."

Mr. Wilson regards these three inventions as so nearly equal in utility, that he would be guided in his choice of either by their cost and durability. "Our smoke consumers" says he, "do as much work with small coal as the old furnaces did with large." The saving with the same fuel appears to be about twelve per cent.

At Messrs. Truman, Hanbury, & Buxton's, brewers, Jukes's furnace has been used for four years, with great economy and success. Twenty years ago, viz., May 24, 1834, a patent on a similar principle was granted to Captain Bodmer, an eminent engineer of Manchester.

Samuel Hall's patent has been successfully worked in many instances, among others, at Woolwich Dockyard. It is said to be expensive.

The use of smokeless fuel has been adopted by many persons as best adapted for their particular cases. Welsh coal, coke, and various patent fuels are used. These act, by producing very little smoke, and that little is more easily prevented than under ordinary circumstances, but unless

there is sufficient quantity of air above the fuel, there is great waste with these fuels, as well as with common coal.

At the present prices, anthracite is stated to be an expensive sort of fuel, and sometimes there has been a difficulty in procuring it at all. It is, however, expected, that the supply will in future be more regular, and the price lower, and many persons have found it to their interest to use this sort of fuel.

A striking instance of pretty general success is presented by the case of Manchester, a local act for which borough requires that "furnaces shall, in all cases where the same shall be practicable, be constructed so as to consume or burn the smoke."

Joseph Heron, Esq., the town-clerk, in his communication on this subject states, "that the practicability has been so often proved, and is now so easily demonstrated by reference to existing works, *that it is no longer disputed, but taken as admitted* before the justices." In proof of the great improvement effected by the operation of the law, Mr. Heron copies a table showing the duration of smoke from twenty chimneys, as observed before the act came into operation, as contrasted with their present state. From this table it will be seen, that at that time, fourteen of these chimneys emitted smoke during more than four and a half hours out of nine; that six only emitted smoke for a shorter period; that three smoked almost without any intermission, *i. e.*, more than eight hours out of nine; that five smoked more than seven hours, and eleven more than five, and that none smoked less than one hour and fifty minutes. Mr. Heron now reports that the present state of the mills named in the table may be described in one word as most satisfactory; dense smoke is hardly ever seen, and smoke of any description is very rarely and only for very short periods observable from any of their chimneys. If ever seen to an objectionable extent, it is the result of carelessness on the part of the stoker or fireman, and an intimation from the Town-hall at once secures the attention necessary to abate altogether the nuisance.

Many instances in proof might have been given; for example, Messrs. Cook & Co. (of the Oxford-road Mills) made many experiments for preventing smoke previously to the year 1845, and on being then summoned before the justices, declared they had done all in their power to improve the state of their chimneys, and despaired of being able to make less smoke; they promised, however, to persevere, and try if anything further could be done, and the result soon was and has been since, that a stranger now looking at their chimneys might, and probably would, suppose that the mill was not working. It is understood this satisfactory working of good apparatus, which before had failed, was obtained by making a small addition to the fireman's weekly wages when he succeeded in preventing smoke, and a large deduction when he failed.

Mr. Heron does "not intend to say that the smoke nuisance is entirely abated. Much has been done, and the practicability of doing more has been abundantly proved, but of course in many cases difficulties are encountered, arising either from the want of boiler room, or the want of money to make the necessary alterations, which it is difficult to surmount, and even where the alterations have been made, constant attention and watchfulness are required."

The Board regret to learn that with all the improvements effected, Manchester is still a very smoky place.

One main difficulty in effecting the object in question is the want of means to secure the attention and watchfulness required. It has been suggested, that it would be highly useful for this purpose to keep a number of constables on the constant watch. If a few men were stationed upon some of the highest buildings in London, for example, such as the Monument or the Victoria Tower, a very small number would be sufficient, to keep all the chimneys of London under constant observation, and the officers would be near enough to identify any cases of breach of the law. It is only by some such plan of constant watching that this grievous nuisance can be quickly abated.

Mr. Heron concludes by saying, "I feel that I may say, without fear of contradiction, that the result of our own experience has at least proved beyond dispute, that in few, if in any cases, can the impracticability of consuming smoke be with propriety urged in justification or excuse for the nuisance." From a man who has had such excellent opportunities for forming a correct opinion as the town-clerk of Manchester, such a statement is of the utmost importance. It is completely confirmed by the results of Mr. Houldsworth's extended experience. Mr. Houldsworth has proved by his own practice, that the duration of the nuisance of dense smoke from furnaces, of even the most simple and common construction, can be reduced from forty per cent. of the whole time, to five per cent., at little or no cost for the alteration of the furnaces, and with a positive saving of coals. He, therefore, represents that there need be little hesitation in bringing legislative pressure to bear sufficiently to lessen the evil in a great degree at once; while, if time be given for the gradual replacement of the old by new boilers, with double furnaces, and an union of the flues close behind the bridges, and provision for the admission of air at that point, the smoke nuisance may be almost entirely abated, and the manufacturing towns free from the reproach. Little, however, will be done without smoke inspectors to warn and teach, and to initiate legal proceedings where parties are refractory. From the communications received it appears, that nearly perfect success has been attained by various contrivances, and in many cases without any contrivance at all by good stoking alone, and in others by the use of smokeless fuel, but that good success has rarely been attained without increased care by the stoker. Such care it is unreasonable to expect without in some way or other making it his interest to succeed, and at the same time providing him with a furnace by which he can succeed without very much additional labor.

A useful memorandum on this subject by J. A. Yarrow, Esq., C. E., will be found in the Appendix, wherein he shows that, by a weekly payment of five shillings in addition to wages, coke was saved to the value of 2*l.* 16*s.* per week, the saving in the consumption repaying the increase in the wages eleven times over.

It appears that many contrivances for preventing smoke which are very successful at first, subsequently fall into disrepute. An explanation of many of these cases is afforded by the fact that, as already stated, good stoking is essential to success under any circumstances. This is

secured while the invention is new, and while the inventor perhaps pays the stoker to make it succeed, but it fails when no special care is taken.

The communications concur in further representing that besides good stoking it is essential to have sufficient boiler surface, so that the requisite heat can be obtained from extended flues instead of from a fire unduly urged. Bad stoking and insufficient boiler surface are by many of the witnesses stated to be the main causes of smoke. Both of these causes it is evidently in the power of the manufacturer to remove, and the want of them cannot be justly pleaded in excuse for a public nuisance. It is, however, satisfactory to know that good stoking and sufficient boiler room are so economical to the manufacturer, that the cost of procuring those advantages is very soon repaid by the mere saving in fuel.

The evidence further shows that though special contrivances are seldom essential, they are often perhaps generally useful; that there are almost innumerable patented inventions for this purpose, and that many of these are expired, of which, therefore, manufacturers may avail themselves if they please, without the infringement of any right.

Among such expired patents which have enjoyed a high celebrity, may be particularly mentioned Parke's split bridge, patented in 1820, since copied in numerous forms; and Williams's Argand furnace, patented in 1839, instances of the almost perfect success of which are very numerous. This has been the type of numerous recent patents. It was with this that Mr. H. Houldsworth conducted his celebrated experiments detailed to the Commons Committee of 1841, by which he proved a saving by the prevention of smoke alone of 18 per cent. on the year's operations, and of 35 per cent. where particular care was taken. He states that a still greater saving might be attained had he had the command of more extended boiler surface. Mr. H. Dirk, the late proprietor of this patent, states that any intelligent bricklayer may set up the whole apparatus for 30s. to 60s. for a thirty-horse boiler. That above 2000 have been erected, and wherever they are out of use it must be from sheer neglect. It is admirable for steam-boats, in proof of which ample evidence is given. Another very successful contrivance is the duplex furnace, *i. e.*, two furnaces with one flue, each being fed alternately, so that one fire being always clear, burns the smoke of the other. If this be combined as in Mr. Fairbairn's furnace with a channel for the admission of air beyond the fuel, so that one furnace passes an excess of heated air, and the other an excess of smoky gas (which burn as they mix,) the prevention of smoke is said to be very complete and perfect as long as the stoker takes care to keep one fire always bright. If, however, as is often the case, he feeds them both together, the object is of course defeated. A furnace on this principle was patented by William Losh, as early as 1816, and another by Thomas Hill in 1839, both of which patents are expired. How the existing patents for the same arrangement of fires differ from these and from each other has not been distinctly stated.

This is the plan said by Mr. Heron to be most in favor in Manchester, where the success in preventing smoke has been very great. This construction of furnace is stated to have other important advantages besides that of permitting the smoke to be perfectly and economically prevented.

(To be Continued.)

*East Indian Iron.**

We are glad to be able to add to our former good reports of the manufacture of East Indian iron. There will very shortly be five furnaces at work at Beypore. The ores of Malabar have proved as tractable in the smelting process as those of Salem; and the produce has quite sustained the expectation of the Board, whether as regards the yield or the quality of the iron for forge or foundry purposes. In proof of this, during four weeks of the month of January last, 135 tons of pigs of an excellent quality were yielded at Beypore by 216 tons of ore and 209 tons of charcoal fuel. In other words, about 32 cwt. of ore, and 32 cwt. of fuel, costing not more than 5s. 3d. and 18s. 6d. per ton respectively, according to the "cost sheet" furnished, have been found sufficient to make a ton of pig iron, the expenditure on account of labor at the furnace being at the same time at the rate of 8s. 10d. per ton of pig. The Madras railway from Beypore is progressing with great rapidity; and the company has contracted for all the wrought and cast iron work of the Beypore station.

Artificial Stone. †

Chalk, either in the lump, or reduced to a paste, and steeped in a solution of silicate of potash, absorbs a considerable quantity of silica. It acquires a smooth appearance, close grain, and yellow color. The stone thus prepared takes a very fine polish, and hardens by degrees from the surface to the interior. This process may be advantageously employed for making mouldings, delicate sculptured ornaments, &c.

Ancient monuments of calcareous stone may be preserved by washing with silicate of potash. White limestones are silicated with double silicate of potash and manganese. When the stones are too dark, excellent results are obtained by suspending in the silicate a little sulphate of baryta, which penetrates into the porous stone along with the silica, and remains there in a state of combination. The joinings may be concealed by fragments of the stone ground up to powder, mixed with the silicate of potash, and applied as a paste.

On Working Steam Expansively in Marine Engines. By Mr. E. A. ALLEN, of London.‡ §

It is proposed in the present paper to consider the practical or commercial advantages of working steam expansively in the marine engine, as distinguished from the theoretical advantages, which latter are better understood and more generally admitted.

It has been established theoretically, that considerable economy is obtainable by working steam expansively. Thus—if steam be allowed to

* Lond Practical Mechanics' Journal, October, 1855.

† From the London Artizan, Sept., 1855.

‡ From the Lond. Mechanics' Mag., July, 1855.

§ The substance of a paper read at the last Meeting of the Institution of Mechanical Engineers, Birmingham.

occupy or expand into twice the space it originally occupied, the power developed would be as 1.7 to 1, and according to the following Table :—

Spaces occupied by } Steam, ...	1	2	3	4	5	6	7	8	9	10
Power developed, .	1	1.7	2.1	2.4	2.6	2.8	3.0	3.1	3.2	3.3

The same volume of steam being used in all cases, and allowed to occupy the increased spaces during expansion.

Notwithstanding that this has been long known, it has only been comparatively recently that practical benefit has been derived to any considerable extent from working steam expansively, and even at the present day the principle is but imperfectly recognised, or at least is very inadequately carried out in practice.

The attention of the Institution has been called on several occasions to the advantages of working steam expansively, both in engines employed in manufactories and in mining works and also in locomotives; and the papers of Mr. Fairbairn, Mr. Samuel, and Mr. Clark, have taken up the subject in reference to those particular cases.

The object of the present paper is confined to the advantages of working steam expansively in *marine engines*, and to endeavor to arrive at the causes which have hitherto prevented the principle from being as successfully carried out and as productive of economy as in the case of pumping or other stationary engines.

It would almost seem that the apparent necessity of making the engines of steam vessels occupy the least possible space, actually prevented, for a very long time, any attempt whatever being made to economize fuel; everything being overlooked or considered unimportant when compared to the supposed advantage of having the engine space as small as possible.

It was very natural that the first step in the economizing of fuel, by working steam expansively, should be taken in places where the spaces which the engines occupied could be almost indefinitely increased; and we find, consequently, that the system of working expansively made very great progress, and may almost be said to have been perfected in pumping and winding engines, before its value was at all recognised in other cases. Pumping engines had been worked on the expansive principle for some time, before any attempt was made to carry it out in engines employed in the manufacturing districts; this being chiefly owing to the cheapness of coal and the consequent disregard of economy, and also to the circumstance of a more uniform motion being required.

It will be seen that in the case of engines of manufactories, the ground space was but little more limited than in the case of pumping engines, and probably quite as little limited in respect to vertical height. The boiler-room in these cases was also almost unlimited, as also was the weight of the machinery, and it was not until the principle of expansion was considered with reference to marine engines and locomotives, that the objections to increased bulk and weight of the machinery became, or appeared to become, so important, as to prevent its being carried into practice.

One very important matter appears to have been overlooked in considering the weight of the marine engine, and that is, that it is not simply the weight of the machinery that has to be considered, but the joint weight of the machinery and fuel. It is true that in the case of the first steamboats the weight of the fuel carried did not form so important an item as at the present time; yet, as compared to that of the engine and boiler, it was, and always must be, considerable in every steam vessel. In river boats it may be taken roughly at about one-quarter the entire weight of engines, boilers, and water, equal to about $2\frac{1}{2}$ days' consumption, this being the least proportion.

The following Table gives the weight of coals usually taken by steamers, according to the length of voyage, &c.:

TABLE I.
Proportion of Weight of Coals to Weight of Machinery.

Class.	Service.	Station or Employment.	Number of Days' Consumption.	Proportion of Weight of Coals to Weight of Machinery.
1	River, ...	Thames and Clyde,	$2\frac{1}{2}$	$\frac{1}{4}$ th.
2	Coasting and Continental, . . . }	General Steam Navigation Company, } Colliers, &c., . . }	10	Equal.
3	Ocean, Short voyages,	{ America and Government, . . }	15	$1\frac{1}{2}$ times.
4	Ocean, Long voyages	Australia, ...	40*	4 times.
5	Ocean, proposed voyage out and home, . . . }	India, &c., ...	70	7 times.

It will thus be seen that, except in river steamers, any saving in the quantity of fuel must be of vital importance, and the more so in proportion to the length of voyage.

In the large steamer now constructing for the Eastern Steam Navigation Company, the quantity of coals taken is proposed to be seven times the gross weight of machinery, so that any small per centage of saving would really amount to a considerable quantity.

On one occasion the *Cræsus* took nearly 1400 tons of coals, being about in the proportion of 7 to 1 to weight of machinery. This quantity was intended to work her outward and part of homeward voyage.

It will be found that, as a general rule, marine engines are only using their steam expansively to a very small extent, the steam usually being cut off at $3\cdot4$ ths of the stroke, thus economizing in the ratio of 1·3 to 1 only, or say practically equal to a saving of 20 per cent. on the coal consumed, if no expansion were allowed to take place.

This amount of expansion is given by the slide alone having sufficient lap on the steam side. It is now usual, however, to fit expansion valves to the Government engines, as well as to many in the merchant service, for the purpose of working expansively when short of coal, or when the

* Steamers taking coal equal to only four times the weight of machinery, are obliged to coal on the way out and home.

vessels are running with a fair wind ; but these appliances are never designed for continual working. The "link motion" is also used in marine engines for occasional expansive working.

From a pamphlet recently published by Captain J. C. Hoseason, lately commanding the *Inflexible*, it appears that so far back as 1842, the attention of the Admiralty was called to the subject now in hand, viz : the economy of expanding steam. But at that time the principal difficulty in using steam expansively was doubtless the low pressure at which the boilers were worked, being only about 5 lbs. per square inch.

It appears, however, that in 1842 the pressure in the boilers of the *Inflexible* was raised from 6 to 8 lbs., by Captain Hoseason's desire, and the pressure in the *Terrible* was fixed at 10 lbs.

In 1849, the Indian Government obtained a paper on the expansive action of steam from Messrs. Maudslay, Sons, and Field ; and from the extracts given in Captain Hoseason's pamphlet, it would appear that the case was fairly made out.

To prove the extent to which the *weight of the machinery* could be increased without increasing the *gross weight* carried, the following example is given :

"Suppose a vessel with 400 horse-power engines working up to their full power ; the consumption would be 30 tons per day, and she would carry 750 tons of coal, which would be 25 days' consumption.

The 400 horse engines would weigh	.	.	300 tons.
Coal,	.	.	750 "
Total weight,	.	.	<u>1050</u> "

"Suppose the same vessel with 600 horse engines, but only working up to 400 horse-power, the consumption would then be $22\frac{1}{2}$ tons per day, and she would carry 600 tons of coal, which is $26\frac{1}{2}$ days' consumption.

The 600 horse engines would weigh	.	.	450 tons.
Coal,	.	.	<u>600</u> "
Total weight,	.	.	<u>1050</u> "

"Thus, with the larger engines, the vessel will carry $1\frac{1}{2}$ days' more coal than with the smaller engines, and would save during 25 days the value of 150 tons of coal."

These facts having been pointed out so forcibly six years ago, it appears strange that the principles upon which they were founded should not have been carried out more fully than they have been. Comparatively, however, nothing has been done, although with respect to the Australian vessels, the necessity of economizing has increased threefold, from the quantity of coal required to be carried being just about three times that taken by the Government vessels, viz., about 4 times the weight of machinery, instead of $1\frac{1}{2}$ times. It will be seen that as the necessity for economy increases, so does the facility or means of producing it increase, from the great proportionate weight of coal upon which a reduction can be made, in order to compensate for any increase in the weight of machinery.

In such cases as the Australian vessels, where the weight of coals carried amounts to 4 times the weight of machinery, a saving of 25 per cent. of the coals would allow of the weight of the machinery being doubled, without the gross weight being increased.

Take, for example, engines of 400 horse-power, weighing 300 tons, and the coals carried 1200 tons, making a total of 1500 tons. If the coals by more economical working can be reduced to 900 tons, then the engines may be allowed to weigh 600 tons, and the gross weight to be carried will only be the same, the coal saved being equal to 300 tons. Extending Messrs. Maudslay's example, it will be seen by the following Table II, to what extent the weight of the machinery could be increased without adding to the gross weight, in the case of the coals carried being equal to 4 times the weight of machinery, the power worked up to being the same.

TABLE II.

Showing the increased weight of Machinery caused by increasing the nominal horse-power or size of the engines, and also the necessary reduction in the quantity of coals taken, so that the gross weight may remain the same.

Power W ked to.	Nominal Horse-power.	Weight of Machinery.	Weight of Coals.	Total weight carried.	Consump- tion per day.	Number of days' Consumption.
H. P.	H. P.	Tons.	Tons.	Tons.	Tons.	Days.
Full.	400	300	1200	1500	30	40
400	600	450	1050	1500	22½	45
400	800	600	900	1500	22	45
400	1000	750	750	1500	19	40
400	1200	900	600	1500	18	35

From this it seems that an increase in the weight of machinery to 2½ times, still admits of coals sufficient to work for as many days, and saves 450 tons of coal.

The object of the present paper is somewhat different from that aimed at in the pamphlet referred to, although nearly the same considerations are involved. It was then desired to show that both the power and weight of the engines could be increased without increasing the gross weights carried, the increased power being only occasionally used—this being a most important point for war steamers, and others, when working against the hurricanes in the Indian seas, &c. This advisable increase of power, however, involves a corresponding increase in the first cost of engines, though attended with counterbalancing advantages.

It is proposed now to show how the *engines alone may be increased* in size for expansive working, and consequently slightly increased in weight, not only without increasing the gross weight carried, but how it can be done so as very materially to *lessen the gross weights* carried, that is, in coal and machinery, leaving greater stowage for cargo.

It is presumed that the power placed in vessels is now sufficient (whether it is so or not does not affect the present question,) and therefore in the examples given no provision is made for the engine power being even temporarily increased, although this would probably, in many

cases, be a great desideratum. Neither are the boilers supposed to be increased, either in number or size; but, to avoid complicating the deductions, they are supposed to remain the same, especially since at present marine boilers are too much overworked to last any length of time, and an increase of boiler room relative to the power would be desirable.

Strictly considered, however, the weight of the boilers would be diminished in about the proportion of the diminution of coal consumed.

Taking the five classes of steamers given in the preceding Table I, which shows the weight of coals usually taken in the several cases, it will now be necessary to give the spaces occupied by them in proportion to that occupied by the engines, exclusive of the boilers and passages. The following Table III, shows the floor or horizontal space occupied by the coal-bunkers in the five classes of steamers.

The engines, boilers, and water are supposed at 13 cwt. per horse-power.

The space occupied by coals is taken at 45 cubic feet per ton.

The floor space occupied by engines alone is taken at $\frac{3}{4}$ square foot per horse-power.

TABLE III.

Proportion of space occupied by Coals to that occupied by Engines alone.

Class.	Station of Service.	Weight of Coals in terms of weight of Machinery.	Depth of Coals in each Class of Vessel, approximate.	Horizontal or floor space occupied by Coals, in proportion to Engines alone.
1	River, ...	$\frac{1}{4}$ th.	9 feet.	Equal.
2	Coasting and Continental,	Equal.	12 feet.	3 times.
3	Ocean, Short Voyages, and Government, ...	$1\frac{1}{2}$ times.	20 feet.	3 times.
4	Ocean Long Voyages, . . .	4 times.	25 feet.	5 times.
5	Ocean Proposed Voyage out and Home, ...	7 times.	50 feet.	5 times.

It will be seen from the above Table, that in the case of Government vessels, where the weight of coals is usually equal to $1\frac{1}{2}$ times the gross weight of machinery, the horizontal space occupied by the coal may be taken at 3 times the space taken up by the engines themselves (that is, exclusive of boilers and passages,) or about equal to the total machinery space, if the boilers and passages be included.

In the example quoted above from Messrs. Maudslay, where the coal weighed $2\frac{1}{2}$ times the machinery, instead of $1\frac{1}{2}$ times, which is the quantity more generally taken, the horizontal or floor space occupied would be 5 times that occupied by the engines alone, instead of 3 times as given above. So that supposing the passages left the same, the 400 horse-power engines could be replaced by engines of 600 horse-power, and the saving of space required for coal would balance the increased space occupied by the engines, consequently leaving the total weights carried the same, and the total space occupied by machinery and coal (taken together) the same, with the 600 horse-power engines, as with the 400 horse-power.

[The author here gives another Table for the purpose of showing the relative weights of the different parts of the machinery in steam vessels, taken from two tenders supplied to the Government for paddle-wheel engines of 260 horse-power, and screw engines of 450 horse-power; showing also the average of 18 estimates sent to Government by different engine-makers, giving the separate weights of the various parts of the machinery (as the engines, boilers, water, wheels or screws, &c.) and from it draws the conclusion that it will be sufficiently near for his present purpose to consider the relative weights of the different parts of marine engines to be as follows,] viz :

	Per nominal horse-power.
Engines, ...	5 $\frac{1}{4}$ cwt.
Boilers and fitting, ...	3 "
Water, ...	2 "
Wheels or screw, ...	1 "
Spare gear, ...	$\frac{3}{4}$ "
Coal-bunkers (containing about 15 cwt. per horse-power,)	$\frac{3}{4}$ "
Total, ...	13 "

The practical applications which are made of these particulars in the calculations contained in this paper are, first, that the weight of marine machinery may be fairly assumed at 13 cwt. per nominal horse-power; and secondly, that the weight of the engines and spare gear together may be taken at *one-half* of the gross weight of machinery. This consideration is of much importance, as it is the engines alone that are supposed to be increased in size and weight, to admit of greater expansion of the steam; the boilers and wheels or screw being supposed to remain the same, as has been before stated.

(To be continued.)

For the Journal of the Franklin Institute.

Mechanical Engineering as applied to Farm Implements. By H. Howson, Civ. Eng.

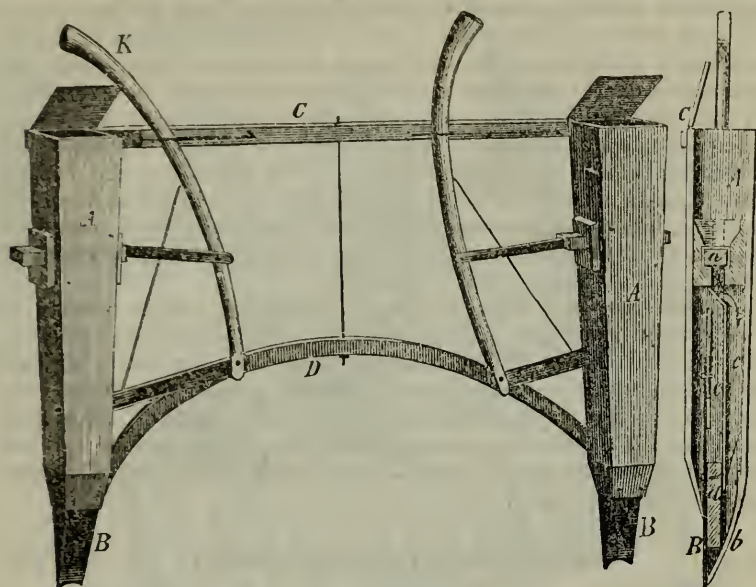
(Continued from page 45.)

Malone's Hand Corn Planter.

The writer's attention has been directed to another ingenious implement for planting corn by hand, an implement which possesses some of the characteristics peculiar to that of Mr. Wakefield's, illustrated and described in the last paper on this subject. Although not so simple perhaps, or so easily operated as the last named machine, the patented hand planter of Malone certainly possesses the important advantage of making two distinct deposits of seed in the soil at one operation.

In the annexed engraving of this implement, one view of which represents an external elevation, the other a vertical section; A, A, are two light tapering boxes of wood, the upper portion of which contains the seed to be planted. These boxes are placed a suitable distance apart, and are connected together at the top by light cross bar c, and towards the bottom by the arched piece n, and are furnished with iron shoes or planting points, B. Two bell crank levers, the long arms of which are

furnished with handles *k*, have their fulcrums on the arched piece *D*, the short arms passing through slotted openings in the lower portion of the boxes *A*, the ends of each arm being connected to a plunger *d* (see sectional view). This plunger is arranged to slide vertically in a compart-



ment *e*, which is separated from the external compartment *c*. The upper portion of each box which contains the seed, is separated from the lower which contains the above mentioned compartments, by a partition in which works the horizontal slide *a*, this has two openings, either one or both of which may be made to coincide with a vertical passage in the partition communicating with the compartment *c*, only. The slide *a*, of each box is connected by means of a jointed rod to one of the bell crank levers. A spring *b*, is secured to the lower end of each box, and presses with its point against the planting shoe *B*, when not otherwise disturbed by the operation of the plunger *d*.

In using this implement, the operator grasps the handles *k*, on the long arms of the bell crank levers, one in each hand. On raising the instrument from the ground after making one deposit of seed, the handles have a tendency on account of the peculiar position of the levers to be drawn towards each other; this movement raises the plunger *d*, and draws inwards the slide *a*, admitting as many grains of corn into the compartment *c*, as the openings in the slide *a*, are regulated to allow. As the spring *b*, is



released from contact with the plunger *d*, it closes against the shoe *b*, preventing the kernels of corn which now drop to the bottom of the planting point, from escaping before the next movement of the machine takes place. The operator now carries the implement to the distance required for making another deposit of seed, and then strikes it down with such force as to cause the points of the boxes to penetrate a sufficient depth into the soil; he now pushes the handles *k*, apart from each other, which causes the slides *a*, to be projected outwards to such a position that their openings may receive another supply of seed preparatory to their being again brought to coincide with the vertical opening which communicates with the compartment *c*. This pushing of the handles apart, likewise causes the short arms of the levers to press down the plunger *d*, in the compartment *e*, so as to open the spring *b*, and force the grain already deposited in the extreme point of the box, into the soil, when the first operation may be repeated.

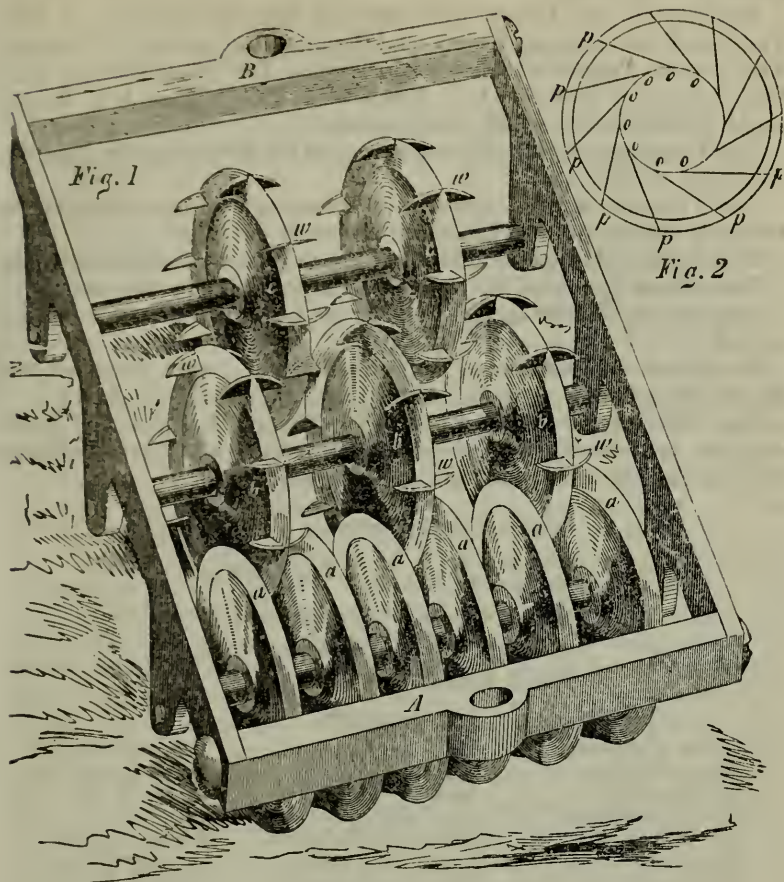
The above is one of those farm implements which may be constructed of very light materials, without sacrificing the quality of durability. With the exception of the metal springs *b*, and shoes *b*, and a few light iron ties, the whole is made of wood sufficiently strong to withstand any shocks to which it may be submitted. The whole weight of one of these contrivances is stated to be no more than ten pounds, and the inventor says, that an active operator when accustomed to its use, can plant from four to five acres per day.

H. M. Johnson's Rotary Cultivator.

As a specimen of a class of farm implements, which during the last four or five years' use, have been partially used in several parts of the Union; is annexed, a perspective view and diagram of a rotary cultivator, invented and patented by H. M. Johnson, Esq., of Carlisle, Pa. This machine consists of a frame work, constructed with two end pieces, *A* and *B*, and two side plates, all secured firmly together.

In the side frames three shafts have their bearings, the first shaft being furnished with a series of circular rotary cutters *a a*, with sharp edges, their sides being slightly concave. The next shaft has another set of wheels *b*, precisely similar to the former, but having on their edges a series of knives *w w*, projecting laterally at such an angle as the wheels revolve and advance, that they descend edgewise, and ascend flat-wise, tearing up the earth from the bottom of the cut. The direction of these knives is indicated in the diagram, fig. 2, by the lines *o p*. The revolving cutters *b*, are so arranged as to pass alternately between the first wheels *a*, the width of the knives *w*, being just sufficient to clear the sides of the latter without coming in contact. The third shaft is furnished with revolving cutters similar to those on the second, the former passing between the latter as in the first instance. The action of this machine when drawn over the ground will be easily understood without further description. The patentee claims "a system of sharpened disks or rotary cutters, a part of which are armed, upon their periphery with knives projecting laterally, said knives being set obliquely to the radius of the

disk as described, the whole being combined and arranged in three se-



veral sets, so that the two sets armed with knives, shall cut alternately sections of the soil as set forth."

(To be Continued.)

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, January 17, 1866.

John C. Cresson, President, in the chair.

John Agnew, Vice President.

John F. Frazer, Treasurer.

John P. Parke, Recording Secretary, pro tem.

The minutes of the last meeting were read and approved.

A letter was read from Messrs. J. F. Reigart and J. Dellinger, of Lancaster, Pennsylvania.

Donations to the Library were received from The Society of Arts, The Royal Astronomical Society, and the Statistical Society, of London; The Austrian Engineers' Association, Vienna; The Texas Western Railroad Company; Professor J. A. Kirkpatrick, Philadelphia; J. F. Reigart and J. Dellinger, Lancaster, Pennsylvania.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer read his statement of the receipts and payments for the month of December, also his annual statement for 1855.

The Board of Managers and Standing Committees reported their minutes.

The Annual Report of the Committee on Publications was read.

Two resignations of membership in the Institute were read and accepted.

Candidates for membership in the Institute, (7,) were proposed, and the candidates proposed at the last meeting, (17,) were duly elected.

The Tellers of the Annual Election for Officers, Managers, and Auditors, for the ensuing year, reported the result, when the President declared the following gentlemen duly elected:—

John C. Cresson, President.

John Agnew, }
Matthias W. Baldwin, } Vice Presidents.

Isaac B. Garrigues, Recording Secretary.

Frederick Fraley, Corresponding Secretary.

John F. Frazer, Treasurer.

MANAGERS.

Samuel V. Merrick,
Thomas Fletcher,
Abraham Miller,
John C. Trautwine,
John H. Towne,
Edwin Greble,
David S. Brown,
Thomas S. Stewart,

Owen Evans,
Alan Wood,
John E. Addicks,
Isaac S. Williams,
Henry P.M. Birkinbine,
George W. Conarroe,
Thomas J. Weygandt,
Joseph J. Barras,

John McClure,
Joseph Harrison, Jr.,
George Erety,
Evans Rogers,
Robert Cornelius,
Lawrence Johnson,
George C. Howard,
Jacob Weaver.

AUDITORS.

Samuel Mason,

Algernon S. Roberts,

James H. Cresson.

At a meeting of the Board of Managers, held January 23d, 1856, the following officers were elected for the ensuing year.

George W. Conarroe, Chairman.

Isaac S. Williams, }
Owen Evans, } Curators.

On motion of Dr. A. L. Kennedy, it was

Resolved, That the Committee on Exhibitions be requested to confer with Committees from other public Institutions, on the subject of the next Exhibition of the United States Agricultural Society in this City, and to

report at the March Meeting on the expediency of this Institute participating in said Exhibition.

BIBLIOGRAPHICAL NOTICES.

The United States Naval Astronomical Expedition to the Southern Hemisphere during the Years 1849-'52. By Lieut. J. M. GILLISS, Superintendent.

The United States Government certainly deserves credit for the liberality with which it contributes by every method in its power to the increase and improvement of science, and when we consider the limited nature of its powers, and the jealousy with which every step beyond their literal construction, is regarded by the always powerful opposition, it is really to be wondered at that it has ventured so much and with such success. Mr. Calhoun, himself, the strictest of constructionists, was, we believe, the first who ventured on this liberal policy, and his example has been frequently and creditably followed by his successors. Heretofore, much has been to be contended with, and especially the aversion to scientific duties manifested by the older officers both of the army and navy, who had not been educated to such tasks, and could not and did not wish to see the importance of them—saw at all events that they were derogatory to the character of a soldier or sailor. Oddly enough, this prejudice was deeper and longer continued in the navy, where they were compelled to practice some such observations in the fulfilment of their ordinary duties: for the school at West Point soon supplied our army with a body of highly educated young gentlemen, capable of appreciating the importance of their opportunities for increasing knowledge: and it is greatly to the credit of the navy that without such a means of education, and in face of the greatest difficulties arising from the manner in which the appointments are made, there has grown up within it so many scientific observers.

In the year 1848, the American Philosophical Society of Philadelphia, and the Academy of Arts and Sciences of Boston, addressed memorials to Congress, setting forth the importance to astronomical science, of certain observations of the inferior planets to be made at a point in South America, and in accordance with the views expressed and the consequent action of Congress, the Secretary of the Navy appointed Lieut. James M. Gilliss to obtain the requisite instruments and organize an observatory at Santiago, Chili. Lieut. Gilliss after successfully accomplishing his arduous undertaking and obtaining the data required, returned home and reported his astronomical observations, which have been already published by Congress. The present two volumes, are the result of his observations upon the country during his stay, and embrace a quantity of very interesting information in reference to its history, natural, social, and political. Of course during the short time that the book has been lying on our table, we have had no sufficient opportunity to study it closely, but a hasty glance at its contents, and a rapid perusal of those parts that appeared most interesting to us, have left no doubt of its high value as a contribution to our knowledge of this

interesting region, and of the credit which it will reflect on our national character. To annex a new region to our knowledge, is perhaps the most profitable, and certainly, the least objectionable of annexations. That during his absence, a board, appointed by Congress to correct abuses in the navy, should have by some unaccountable mistake, for we cannot believe the insult to have been intended, have reduced his grade in the navy, must, indeed, be mortifying to Lieut. Gilliss; but we cannot conceive, that beyond the sensitiveness of his own feelings and the mere question of pay, it can by any means injure him or his reputation, which he has here established upon a sure basis capable of resisting assaults from any quarter. Whatever his position may be, we are sure that he will always possess as he has merited the confidence of the Department, and will prove one of the most able and honorable officers of our navy.

Polar Sea. Solar Heat Theory; being an attempt to solve the Problem of an Open Polar Sea. With some remarks upon the Gulf Stream.
By SAMUEL HOLLINGSWORTH.

This neatly written pamphlet is another of the numberless illustrations of the axiom that "a little knowledge is a dangerous thing." It is an attempt to account for the existence of an open Polar Sea, by the doctrine of the maximum density of water at 39.5° Fahr. The idea is a specious one, and the reasoning plausible: had it been confined to the present author, we should not have noticed it, but as it is found in recent works of much higher pretensions, and appears to be spreading to the damage of true science, it is worth refutation. Omitting, then, the serious objections, that the existence of an open sea around the Poles, in the sense in which this term is generally understood, is yet far from being demonstrated; and that no records exist, to the best of our knowledge, of the temperature of such expanses of ocean in these high latitudes as have occasionally been found free from ice; and that the existence of two such crossing currents as are assumed, the one of descending hot water, the other of ascending cold water, is very difficult to imagine if not demonstrably impossible; we may briefly come to the root of the evil, by referring to the researches of Despretz, presented to the Academy of Sciences of Paris, nearly twenty years ago—in which he shows experimentally that while pure water has its maximum density at 4° Cent., (39.2° Fahr.) sea water did not reach such a maximum until the temperature was reduced to 3.67° Cent. (25.4° Fahr.) while its freezing point when agitated was 2.55° Cent. (27.4° Fahr.) In other words, under ordinary circumstances, sea water would freeze before reaching a maximum density. How far in cooling near the freezing point, it deposits its salt and separates into a denser and lighter layer, is not stated. If it be necessary to account for an open sea, when its existence shall have been demonstrated, perhaps great depth of the water may explain the phenomenon, but until the fact is definitely ascertained, and the temperature at various depths are known, it is plainly premature to speculate on its causes.

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CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

On the History and Construction of Iron Lighthouses ; with a Description of the Coffin's Patches Light. By J. VAUGHAN MERRICK.

(WITH A PLATE.)

We have observed in the *Civil Engineer and Architect's Journal* for November, an article descriptive of an iron light tower, constructed for the Island of St. Isaacs, in the West Indian group, which has suggested a few remarks about iron lighthouses generally, and the different methods of using that metal in their construction.

There are few branches of mechanical industry in which the application of iron has effected so complete a revolution as in this one. The erection of lighthouses, is ordinarily a difficult, tedious, and expensive operation ; not unfrequently attended with danger, or sacrifice of life to those engaged in it ; and as delays in the completion of such works not only entail an increase of cost, but are likely to cause maritime loss, involving the destruction of life and property on the part of those for whose benefit they are designed ; it becomes an object of high importance to reduce to a minimum, the labor required at the locations in which they are to be erected. Again, the materials have usually to be transported from a distance, and should, therefore, be as light as possible ; in other words, that material, and that arrangement of form should be adopted, which combine the greatest strength with the least weight ; due regard being had to the first cost and to the durability of the structure. Comparing in these particulars, the materials formerly employed, viz : stone or brick

and that which is at present used, iron ; the advantages offered by the latter are so manifest, as to require no argument in their support, and seem to indicate its exclusive use in future works of the kind.

In the United States, England, and France, many iron lighthouses have already been constructed. Some of these resemble, when completed, the old fashioned stone towers, being composed of cast iron plates, bolted together by transverse and vertical flanches, so as to form when put together a conoidal shell. Others, consist of a network of piles diagonally braced, forming a polygonal structure of a form diminishing in size as it ascends. Before adducing examples of these two types, it may be well to trace a brief history of both. The first record with which we are acquainted, of the idea of employing iron for this purpose, is to be found in Vol. xxvi., p. 1, *London Mechanics' Magazine* ; wherein under date of August 31, 1836, Mr. John Lake, of London, proposed to obviate the liability to destruction of lighthouses from the force of the sea, by elevating the keeper's house and lantern on a metallic column, only two or three feet in diameter, and bracing the former by a series of chains, moored at equidistant points on a large circle described from the centre of the column. How these chains were to be attached, or upon what foundation the central column was to rest, does not appear ; as the idea was evidently a crude one and not worked out by its author. Subsequently, in a letter to the same *Journal*, he proposed to substitute wrought iron tension rods for the chains. About the same time, 1835-36, Mr. Alexander Mitchell, of Belfast, was experimenting with cast iron mooring screws at Bristol, England. These screws, which are undoubtedly the best form of mooring known, he proposed to make from three to four feet diameter, of one thread wound round a conical barrel, the thread enlarging spirally as it ascended from near the point of the central cone to the full diameter. The employment of such mooring screws to secure the bracing rods or chains, would have made Mr. Lake's plan feasible ; but Mr. Mitchell, in August, 1838, began the erection of a lighthouse on the Maplin Sands, which must be considered the pioneer in iron lights, as it was the first one planted on a series of iron piles on the points of a polygon, which, in conjunction with a central pile, should constitute the skeleton or frame of the structure. The Maplin Sands lie at the mouth of the Thames, 20 miles below the Nore, and form the Northern side of the King's Channel. As this is frequented by the larger class of vessels bound to or from London, the position is an important one. The eight piles, arranged in an octagonal form forty feet diameter, and the central one, are all of wrought iron five inches in diameter, twenty-six feet long, shod with cast iron screws, 4 feet diameter ; and were screwed into the sand until their tops were about five feet above low water mark ; upon these, two years afterwards, a superstructure was raised, about 30 feet high, tapering from 40 feet diameter, up to 16 feet at the top ; which is surmounted by a lantern in which a Fresnel Dioptric light, of the second order, is exhibited. The superstructure consisted of hollow iron pipes curved inwards near the top, above which were wooden uprights inclined towards their common centre, and secured together by circles of horizontal iron ties at the height of 6 and 15 feet above low water ; and at the same points to the central pile by radial ties ; also diagonally to the central

pile, but not diagonally together. The latter modification was first introduced into the Port Fleetwood Lighthouse, to avoid a supposed tendency to torsion of the whole when struck by the waves. The latter structure, erected in Morecambe Bay, West Coast of England, and very similar to the Maplin, was the first one *completed*, having been lighted in 1839; it was designed by Mr. Mitchell. It was placed on seven 5 inch piles, 16 feet long, with screws 3 feet diameter; and the iron is surmounted by timbers 48 feet long, supporting a lantern containing a Dioptric of the second order.

The *Screw Pile* Lighthouse, that is to say, a columnar structure supported on screws, is, therefore, the oldest known form of iron lighthouse.* Propositions have, however, been made to modify it in two ways. Dr. Potts, of England, in Dec. 1843, patented what has since been known as the Pneumatic Pile; which is a hollow cylinder of metal, closed at the top and open below, placed upon the sand desired for a foundation, and forced down by exhausting it of air.

By this method, a mooring was, in 1845, secured on Goodwin Sands for a beacon, erected by order of the Trinity Board; and the plan was subsequently adopted by several engineers in England, as a means of obtaining proper foundations for bridges, piers, &c.

In February, 1846, Mr. John de la Haye, of London, writing for the *Mechanics' Magazine*, (Vol. XLIV., p. 157,) proposed the construction of a skeleton lighthouse, by sinking six wrought iron shafts twenty feet or more in the sand by such air-tight cylinders, and at an angle inclined towards a common centre; their tops to be then united by suitable rings, and the whole to be properly braced by iron tie rods. This was, in fact, Mr. Mitchell's lighthouse, modified by the substitution of pneumatic for screw pile foundations; a substitution which seemed unnecessary, as the screws gave entire satisfaction, and were probably less expensive.

The other proposed change is, we believe, peculiar to this country, and consists in adapting the pile lighthouse to hard foundations where the screw would not enter, by pointing the piles and driving them in to the requisite depth; resting the weight of the superstructure on flat disks which surround each pile, and are placed on the foundation, leveled for the purpose.

The first erected on this plan was at Minot's Ledge Rock, about 17 miles below Boston, Mass. This was put up in 1847-8, and was swept away in a terrific gale, which occurred April 17, 1851. It was in a location exposed to the whole fury of the sea, resembling in that respect the celebrated Eddystone Rock, being within fifty feet of deep water. Its loss was principally owing to its narrow base, which was limited by the size of the area of rock on which it stood. Its height was about seventy feet, and its base twenty-five feet; the frame work was composed of nine wrought iron piles, dropped into cavities bored five feet deep in the solid

*NOTE.—It should be remarked, in this connexion, that the columnar nature of these structures is of older origin, and that an example could be seen of a wooden light house, standing and in good condition in 1852, which had been erected in a very exposed situation on the *Small's Rock*, off St. David's Head, in 1778, and was then 74 years old. It is 56 feet high, and was composed of nine oaken piles nearly vertical, fixed to the rock, and protected from the effect of westerly gales, by shores placed against the easterly piles.

rock. The piles tapered from 10 inches at the surface, to 8 inches diameter at the point.

The causes of the disaster at Minot's Ledge were so well understood, that it did not deter the U. S. Government from the construction of other lighthouses on the same plan.

The foregoing remarks have referred only to the Marine Lighthouse, or, in other words, those which are intended for erection on foundations covered by water; and although it is evident, that the last described plan would be applicable to either land or water, yet we must not omit to notice the other plan, designed only for land erection, referred to in the commencement of this article.

In the early part of 1841, Mr. Alexander Gordon, of London, designed and erected at Morant Point, on the eastern end of the Island of Jamaica, a lighthouse resembling in external appearance the stone structures commonly used, but made of plates of cast iron arranged in segments, and bolted together by flanches projecting inwardly. It was $18\frac{1}{2}$ feet in diameter at base, 11 feet at the top, and about 100 feet high to the top of the lantern. This building having been erected at far less expense than one of stone would have been, and having for two years survived the storms and earthquakes common in that vicinity, the same gentleman was subsequently employed to erect a similar one on Gibbs' Hill, Bermuda, which was conoidal like the former, 106 feet high, surmounted by an inverted conoidal capital. The diameter at the base was 25 feet, and at the top 16 feet. About 20 feet of the lower part of this tower was filled in with concrete, in order to increase its stability. It stood on an elevation of about 245 feet above sea level.

Mr. Gordon is entitled to the credit of having first employed cast iron for large sea lighthouses, though the idea of using that material for such a purpose originated (it is believed,) with Sir Samuel Brown, R. N., and a small light tower at Gravesend Pier had been erected before the Jamaica tower was put up.

Other similar towers have, since the period above named, been erected, and it is to one of them that the description refers in the *Civil Engineer and Architect's Journal*, which suggested these remarks. We propose to quote this description, and to follow it by a brief account of the Coffin's Patches Lighthouse, of which the accompanying plate (Plate I.) is an illustration, and which is to be located within a short distance of, and in a similar situation to, that for the Isaacs. The two structures are the largest specimens of their respective types yet built, and we think that a fair and candid comparison of their merits, will show the vast superiority of the open one, and vindicate the preference given to this plan by our Government.

The following is the description referred to:—

There is now in the course of erection at the engineering works of Messrs. Grissell, Canal Basin, near the City-road, a cast iron lighthouse, the ultimate destination of which is the island of St. Isaac's, among the West Indian Islands. This lighthouse is 24 feet diameter at the base, and will rise to the elevation of 150 feet to the top of the lantern. It will diminish upwards from its lower diameter to 14 feet. The entire work is formed of a series of cast iron plates, of about $1\frac{3}{4}$ inch in thickness upon the lower courses, with radiated joints, diminishing to a thickness of $\frac{1}{4}$ -inch in the upper courses. Each joint is formed, not by the usual flanch joint, lapped and bolted, but by a description of double joint, or butt, with an interstice between, which presents a double thickness, through



Iron Pier Light House
for the
OFFSHORE LIGHTS REEF.
on the
Florida Coast,
U. States

Height 160 feet

Diameter 56 feet

which the iron bolts will pass, and through which the plates are screwed together. This principle of jointing resembles the joggle joint in practical masonry, the interstice, or key, between being intended to be filled in with iron cement. There is, however, one peculiarity in the construction of this lighthouse, which consists in the arrangement of the plates, which break joint upon the horizontal bed, and therefore it is not continuous, as in ordinary structures of this description. This circumstance will necessarily occasion an undue strain to arise upon the bolts in the event of any settlement or the slightest dislocation of the plates occurring throughout the structural arrangement. The lower portion of the lighthouse, to the height of 24 or 25 feet, will be filled in with solid concrete, and will at this elevation be entered by an external staircase. The interior will have a spiral staircase ascending to the lantern, and will be filled in with store-rooms, offices, and apartments necessary for the purpose of the lighthouse. The general character of the structure is massive and imposing, and altogether in effect consistent with the purpose to which it will be ultimately appropriated. The weight of the iron work entire will approach 300 tons.—*Mining Journal*.

The American Lighthouse for Coffin's Patches, is intended to form a part of the splendid chain of lights along the dangerous coasts of the Florida Reefs, which has, for some five years past, been in course of erection by our Government,* and which, when completed, will be a lasting monument to a liberal and judicious policy in this Department. It has been constructed under the superintendence of Lieutenant George G. Meade, U. S. Topographical Engineers, assisted by Mr. John W. Nystrom, at the works of Merrick & Sons, Philadelphia. It will have the following general dimensions: height from bottom of piles to base of disks or top of rock 10 feet, from top of rock to high water level at spring tides, 10 feet; from high water level to focal plane, 137 feet; from top of rock to top of spire over lantern, 164 feet 9 inches; from top of rock to top of lantern, 160 feet; diameter at the base and up to 10 feet above high water level, 56 feet from centre to centre of piles. Diameter at the lantern or gallery floor 15 feet from centre to centre of piles; diameter of lantern, (which is of boiler plate, for a height of 8 feet up to the upper gallery,) 12 feet 6 inches; thence glazed with thick French plate glass, same diameter as below, (12 feet 6 inches,) 9 feet high, terminating in a conical top ventilator, and spire. The floor of the keeper's house is elevated 32 feet above high water; and the house itself is of boiler plate lined with wood, 30 feet square by 10 feet in height. From this house, access is had to the lantern by a cylindrical boiler plate trunk 6½ feet diameter, surrounding the central pile, and containing a spiral staircase.

The lower tier of piles are 12 inches in diameter, 30 feet long; the next tier 10 inches diameter, 22 feet long, both of wrought iron. Above the latter, the piles are hollow, of cast iron, diminishing from 12 to 8 ins. external diameter. These several tiers are connected by cast iron sockets, on which the requisite lugs are cast to receive the ends of the various braces and tie rods. The structure is braced by radial and circular ties at each tier of sockets, and diagonally from one tier to the next above and

* In this chain are the following lights; to the North and East, Carysfort Reef, built on piles driven into the reef; Cape Florida, Jupiter Inlet, and others, iron lanterns on stone towers; to the West and South are Sand Key, Rebecca Shoal, and North West Channel in the Dry Tortugas; all on piles screwed into the shoal. On all of them are Fresnel lights. Carysfort is octagonal, 117 feet above the reef, and 112 above the water, 50 feet diameter at the base; the piles are eight inches diameter, and inserted 10 feet. Sand Key is square, (50 feet at the base,) 120 feet high above high water level, 132 feet above the shoal; it rests on 17 piles, 8 inches diameter, which are screwed in twelve feet.

below. These ties are all of wrought iron and of sizes varying from 5 inches to $1\frac{1}{2}$ inches in diameter. The lower piles are sharpened at the ends, and will be driven into the reef at the proper points. Ten feet above their ends, these piles have collars forged upon them, which rest upon the disks to which the lower diagonal braces are attached. The disks are 8 feet in diameter, and lie on flat surfaces prepared for them, thus supporting the whole weight of the structure. The plate shows only those parts which are above the reef.

In the lantern will be exhibited a Fresnel light of the first order.

The weight of the whole is about 300 tons.

The site on which this light will be erected, is the Coffin's Patches Reef or Shoal, situated in latitude $24^{\circ} 41\frac{1}{2}'$ N., longitude $80^{\circ} 58'$ W., at a distance of $58\frac{1}{4}$ stat. miles, W. 15° N. from Sand Key, and $60\frac{1}{4}$ stat. miles E. 42° S. from Carysfort Lighthouse. Hence, one of these lights will always be kept in sight by vessels navigating the coast.

A comparison of the English conoidal tower, with the columnar structure we have described, shows that with the same weight, the latter is 10 feet higher, and $2\frac{1}{4}$ times the diameter at the base, by so much increasing its stability. In withstanding the shocks of waves or the force of gales, a glance at the plate will demonstrate the superiority of a structure entirely open and composed of separated parts, to one presenting a solid surface which would receive their entire strength; while it might be supposed that an excessive settling of any part, would have a more prejudicial effect upon the whole, in the cast iron tower where the attachment of the plates must necessarily be rigid, than in the other, where every bar would yield slightly before breaking.

Translated for the Journal of the Franklin Institute.

The Canal through the Isthmus of Suez.

(WITH A PLATE.)

The Mediterranean Sea as the link of connexion of Europe with Africa, Asia, and the Indies, is one of the most important points on the surface of the Earth. By its position between these continents, by the numerous islands which it includes, by the long peninsula which stretches out into it, by the number and excellence of its harbors, by the immense riches which it distributes, it commands a collection of political and commercial elements which are not to be found on any other point of our earth. Even small and in themselves insignificant States, obtain from their position on the Mediterranean Sea, an importance which bears no comparison with their power. Were we to place Greece with its present size, on the Danube, or in Middle Europe, it would henceforth occupy as insignificant a position in politics, as Serbia, Wallachia, or other continental States of similar size, in place of the inordinate interest which it now commands. And is not the real meaning of the Oriental question, of the existing bloody war, in great part, the struggle for the control of the Mediterranean Sea? On the Mediterranean Sea fought Greeks and Persians, Romans and Carthaginians, Augustus and Anthony for the Empire of the World; and Greece might, perhaps, ever have resisted her con-

querors had she better treasured up the Delphic Oracle, to guard herself with wooden walls (ships).

By the discovery of the Ocean route around the Cape of Good Hope, by the discovery of America, and the conquest of Constantinople by the Turks, as well as by the piracies of the north-western African States, this significance of the Mediterranean Sea was for centuries disturbed, and only the Italian Republics, Venice, Greece, and Pisa, took advantage of it, for the naval power of the Turks was broken at the fight of Lepanto, and Spain prostrated by the Inquisition and civil wars.

How strongly the importance of the Mediterranean has been felt in modern times is shown by the seizure of Gibraltar, the Island of Malta, and the Ionian Island, by the greatest naval nation.

And yet the Mediterranean Sea is at present only a *cul de sac* for ships. A narrow strip of land, scarcely seventy miles broad, obliges the sailor to make a circuit of thousands of miles, and subjects him to a multitude of perils, among which the poisonous fevers and destructive epidemics of the tropics are not the worst. The cutting through the Isthmus of Suez would, therefore, create a new era in politics as well as in trade. By the connexion of the Mediterranean with the Red Sea, the voyage from Marseilles or Trieste to the East Indies will be shortened more than 3000 miles, (French,) between London, Amsterdam, or the Hanse-Towns, and China more than 2000; and even between New York and the south of Asia more than 1000 miles. The reduction of time and capital, which is the necessary consequence of the increased rapidity of transit, will reduce the prices of the absolute necessities, coffee, sugar, and tea, as well as of cotton and silk, by a third; while, in a short time, the wants of civilization, and with them the products of our industry will spread into these lands, whose increase is even now more rapid than their resources. And yet the financial and commercial results of this undertaking, great as they may be, are but trifles when compared with the incalculable results which the opening of the projected canal must have on the civilization of the whole East.

It is true, that it may seem that by the railroad already commenced between Alexandria and Suez, the closer connexion of the two continents is accomplished. But, although the railroad will insure the desired advantages so far as the travel of passengers and correspondence is concerned, yet the most important part of the trade, the goods, must be excluded from it, in consequence of the four handlings in loading and unloading which they will require, from which so much loss and injury must result as will make the route by the Cape still the preferable one.

The importance of this canal, although never so great as at present, was known from the earliest times. The great King Sesostris or Rhamses II., (1380, B. C.,) was, perhaps, the first who conceived the plan of connecting the two seas. He appears to have designed a canal from the Red Sea to Memphis; and the story is not without probability, that in his time a lively trade existed between Egypt and India. One thousand years later, King Nechos or Necho resumed the old plan, but without finishing it. The first works, according to Herodotus, cost the lives of 120,000 men, and were interrupted by an oracle, which warned them of the damage which the Egyptians would suffer should

they thus open the way for strangers into their land. A new attempt was made under the Persian rule, by Darius Hystaspes, but Ptolemy Philadelphus first finished the canal, (280 B. C.,) which was named after him. According to Strabo, this canal was 100 feet broad, 30 feet deep, and 50 miles long. It was provided with locks, which were opened for the passage of ships, and then again closed. The largest sailing ships could use the canal, and made their passage through in from 2 to 4 days. The Ptolemean Canal extended from the Pelusian arm of the Nile, below Bubastis, to Arsinoë, a city on the north-eastern part of the Red Sea. About half-way it cut through the Bitter Lake, as the Rhone does through the Lake of Geneva. It brought with it, at the same time, the advantage of watering a large part of the heretofore desert lands of Suez, so that, in a very short time, a crowd of cities and villages sprang up along its borders.

In the times of the Romans, Trajan repaired this canal, and constructed a new arm, which opened into the Nile near Memphis. This addition was known by the name *Amnis Trajanus* (Trajan's River).

Still these canals appear either to have been never finished, or to have filled up with mud, so that from time to time they had to be re-dug.

The Arabs, also, participated in these undertakings. The historian, El Mazin, relates, that, when under the caliphate of Omar, the cities of Mecca and Medina were visited with a severe famine, the Caliph ordered Amru, the Governor of Egypt, to construct a canal between the Nile and Calzum, (Klysma,) so as to enable the grain to be transported from Egypt to Arabia. Amru fulfilled the command, and called the canal the River of the Commander of the Faithful. One hundred and thirty years later, the Caliph Abu Djaffar Almansor caused it to be closed for the purpose of preventing the advance of Ali, who had revolted at Medina, upon Egypt. This canal exists still at the present day. It cuts through Old Cairo and loses itself a few miles farther north-eastward in the *Birket el Hadschi* (the Lake of the Pilgrims). It is still yearly opened with great solemnity at the rise of the Nile. But even were it in order, it could be used only by Nile boats, not by sea ships, and by the first only at the season of the year when the river is at its highest. After this, Egypt and its importance as a passage into Asia, were for a long time laid out of mind, and, although individual enlightened statesmen, such as Colbert, clearly perceived its importance, yet the French Republic was the first to resume the old plan. General Bonaparte openly declared that the time was not far distant when it would be seen that to shake England's power to its foundation, it was only necessary to possess ourselves of Egypt. The Directory issued the following order on the 12th of April, 1798:—"The General-in-Chief of the Army of the East, will cause the Isthmus of Suez to be cut through, and will use every means which may be necessary to secure to the French Republic the free and exclusive possession of the Red Sea. He will expel the English from all their Eastern possessions, and will, in especial, destroy all their settlements on the Red Sea."

It is known why these plans failed. Moreover, the French engineers affirmed that the difference of the levels of the two seas to be joined, exceeded eight metres, an assertion which is now known to be incorrect.

Now has arrived a moment, in which the generally inimical nations, France and England, are friendly, and when Turkey must be more than usually favorable to the projects of the Western powers. The time has accordingly come at which the work is to be begun.

Two plans already marked out under Mehemed Ali, were presented to the present Viceroy Said, by which the projected canal is either to cut the Isthmus in a direct north and south line from Pelusium (4) to Suez (22,) (Plate II.,) or to follow the track from Alexandria to Suez, and so by using the water of the Nile to benefit the whole Delta. The Viceroy, by the advice of those experienced in the matter, has selected the first plan as the shortest and most effective, and, in accord with the consuls of foreign powers, has issued a firman to the engineer-in-chief, Ferdinand von Lesseps, authorizing him to form a company for the canalling of the Isthmus of Suez. This firman contains the following principal points of concession :—

(1.) The company assumes the expense of the undertaking. It will pay the land owners for the ground taken.

(2.) It binds itself to pay into the Egyptian Treasury 15 per cent., and to the original stockholders, 10 per cent. of the net revenue.

(3.) It recognises the supervision of the Egyptian Government over its tariff of tolls and laws.

(4.) It binds itself to guarantee a perfect equality in the tariff to the flags of all nations, and to allow no exclusive privileges to any one.

On these conditions the company receives :—

(1.) The concession of the canal for 99 years from the day of opening.

(2.) The gratuitous grant of all public land which may be necessary for the canal: these constitute the largest part of the necessary territory.

(3.) 75 per cent. of the net receipts for the stockholders.

(4.) The gratuitous grant of all domains of the state, which, at present uncultivated, shall, by irrigation of the company, be made fertile.

(5.) The right to levy a tax upon the lands of such persons as may use the water of the canal for the purpose of irrigating their land.

(6.) The right to take, without pay, from the state quarries, all necessary materials for the canal, and the buildings appertaining to it.

(7.) The entry, free of duty, of all machines and materials which the company may want for the prosecution of its undertaking.

(8.) Remuneration for the materials left at the end of the concession.

(9.) And, finally, the most solemn promise from the Viceroy, that he will assist the undertaking by all means in his power.

According to the preliminary plan made by Ferdinand von Lesseps and Linant Bey in conjunction with two others of the Viceroy's engineers, the whole length of the main canal from the lighthouse at Pelusium, (1,) to the lighthouse of the Red Sea, (29,) will be 120 kilometres, (74·591 statute miles;) its breadth 100 metres, (109·4 yards;) and its depth 8 metres, (26·256 feet;) and the cost is estimated at 100,000,000 francs, (\$32,000,000.) But in this sum is included the cost of the feeder, which is to connect the main canal with the Nile, and in time of overflow of the river, to lead its waters to the canal. This feeder (41) passes through the Ouadi Torolat or Tomilat, the land of Goshen of the Ancient Hebrews.

The opening of the feeder into the main canal, Nar et Ouadi (Mouth of the Valley,) (41,) forms the Lake Tamsah, (14,) which is made use of as an intermediate haven. In Moses's time, the Red Sea reached this point, and when we see the amount which the Isthmus has gained since that time, the geological opinion prevails, that in pre-historical times, the Red Sea was not wholly separated from the Mediterranean, and that the Isthmus has been formed gradually; an opinion rendered more probable by the shells and other marine remains which the sand and limestone hills of the Isthmus contain.

A main question which was to be resolved by the engineers, and which was subjected to careful examination, concerns the levels of the two Seas, the believed difference of which had heretofore operated as a hindrance to this great undertaking. It appears from the most recent measurements that the level of the two Seas at ebb-tide, is exactly the same; that on the other hand at the flood, the Red Sea rises from 1·8 to 2·5 metres, (5·9 to 8·2 feet,) while the rise of the Mediterranean, at Pelusium, is scarcely perceptible. To overcome this disadvantage, a reservoir (25) will be built at the Red Sea mouth by making a dam across from Suez to the Asiatic Shore. This dam will be provided with sluices, (26), so that the water of the Red Sea, in time of flood, may be let in and retained, and the level of the canal be kept some two metres higher than the level of the Seas at the time of ebb. Although this basin will at first be costly, it is hoped that by dredging machines, it may be kept clear without serious expense.

In the same way the Mediterranean entrance into the canal will be protected by a dam (1) of 6000 metres in length (3·73 stat. miles.) Through the locks in this dam (2) the ships will enter a basin, (3), which will also be used as a mooring place for the boats which accumulate at the mouth.

For the purpose of assuring, for the future, the greatest security to the undertaking, a commission has already been appointed of the most celebrated experts of all nations. To this commission belong, on the part of Prussia, Privy-Counsellor, Lentze; on the part of Austria, Baron Negrelli, Director of Constructions in Lombardy; also, Paleocapa, Minister of Public Constructions at Turin; the English Engineer, Rendel; Konrad, for Holland; Renaud, Inspector-General of roads and bridges in France; Lerussaux, the French Marine Engineer. Austria has, moreover, honorably invited Kubli, the Architect from St. Galls, to accompany Baron Negrelli to Egypt.

It is expected that an undertaking which promises such important results for the future, will find favor with the capitalists of all nations.

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The above account of this important undertaking is translated from a German Journal. Have any steps been taken by our Government to have the United States represented in a project which interests us more than any other nation, except England?—Ed.

EXPLANATION OF PLATE II.

A. The main canal, 120 kilometres (74½ miles) long.

I. Mediterranean entrance to the canal, lighthouse, and harbor—dam 6000 metres (3½ miles) long.

2. Outlet and inlet locks.
3. Reserve basin and mooring place.
4. Tel el Omarein or Faramah. Ruins of Ancient Pelusium.
5. Castle Tineh.
6. Lake Menzaleh.
7. Kantarah del Kasné Bridge for the road to Palestine.
8. Salieh.
9. Ras Caserum. The Cape Casius, of the Ancients.
10. Katieh.
11. Bir el Bouri (6th station of the engineers 9th of January, 1855.)
12. Ruins of Magdalum (Migdol of the Scriptures.)
13. El Gisir. Remains of the ancient canal constructed by Nechos.
14. Lake Temsah. The intermediate harbor.
15. Residence of the engineers.
16. Remains of Serapeum. Buildings probably erected by Darius.
17. Mouth of the ancient canal. Remains of the works.
18. The Bitter Lake; formerly a part of the Red Sea, now dried up.
19. Persian Monument of the time of Cambyses.
20. First station of the reconnoissance.
21. Tel el Klesmeh. The ancient Klysm.
22. Suez.
23. European church.
24. Hotel for the travelers to India.
25. Outlet basin of the Red Sea.
26. Sluices for the purpose of retaining the water of the Red Sea.
- 27 and 28. Point of crossing for the caravans from Cairo to Mecca or Sinai.
29. Entrance from the Red Sea into the canal. Lighthouse and dam.
30. Reservoir for the water of the Nile.
31. " " rain water.
32. Ancient reservoir for the water from Mt. Attaka.
33. Fortress and wells of Hadscherut.
34. Station for the East India post.
35. Wells of Suez.
36. Road to Cairo.
37. Djebel Attaka (Mt. Attaka.)
38. Mt. Avvebet.
39. Mt. Schebrevvet.
40. Mt. Tieh.
41. The branch canal which connects the main canal with the Nile. Ouadi Tomilat or Torolat (Valley of Torolat); the land of Goshien of the scriptures.
42. Ras el Ouadi, (Mouth of the Valley.)
43. Tel Masruta; traces of the ancient Heroopolis of the Ptolemies, with a statue of Rhamses II.
44. Tel Maofer: Succoth of the Bible. First halt of the Children of Israel; now Om Tihiam (Mothers of Tents.)
45. Tel Naim.
46. Etham of the scriptures. Second halt of the Children of Israel.
47. Rouchet el Buzi. Haroth of the Bible, (Exod. xiv, 2.)
48. Baal Zephon.
49. Bir Marah, (The Bitter Springs, Exod. xv, 23.)

On the Application of Volute-Springs to the Safety-valves of Locomotive and other Boilers. By Mr. J. BAILLIE.*

The volute-spring, invented by Mr. Baillie, the locomotive superintendent of the Central Hungarian Railway, was described to consist of "a single plate of steel, wound spirally in a conical shape, and sustaining pressure and deflexion in reference to its breadth instead of thickness.

* From Lond. Journ. of Arts and Sciences, Jan. 1856.

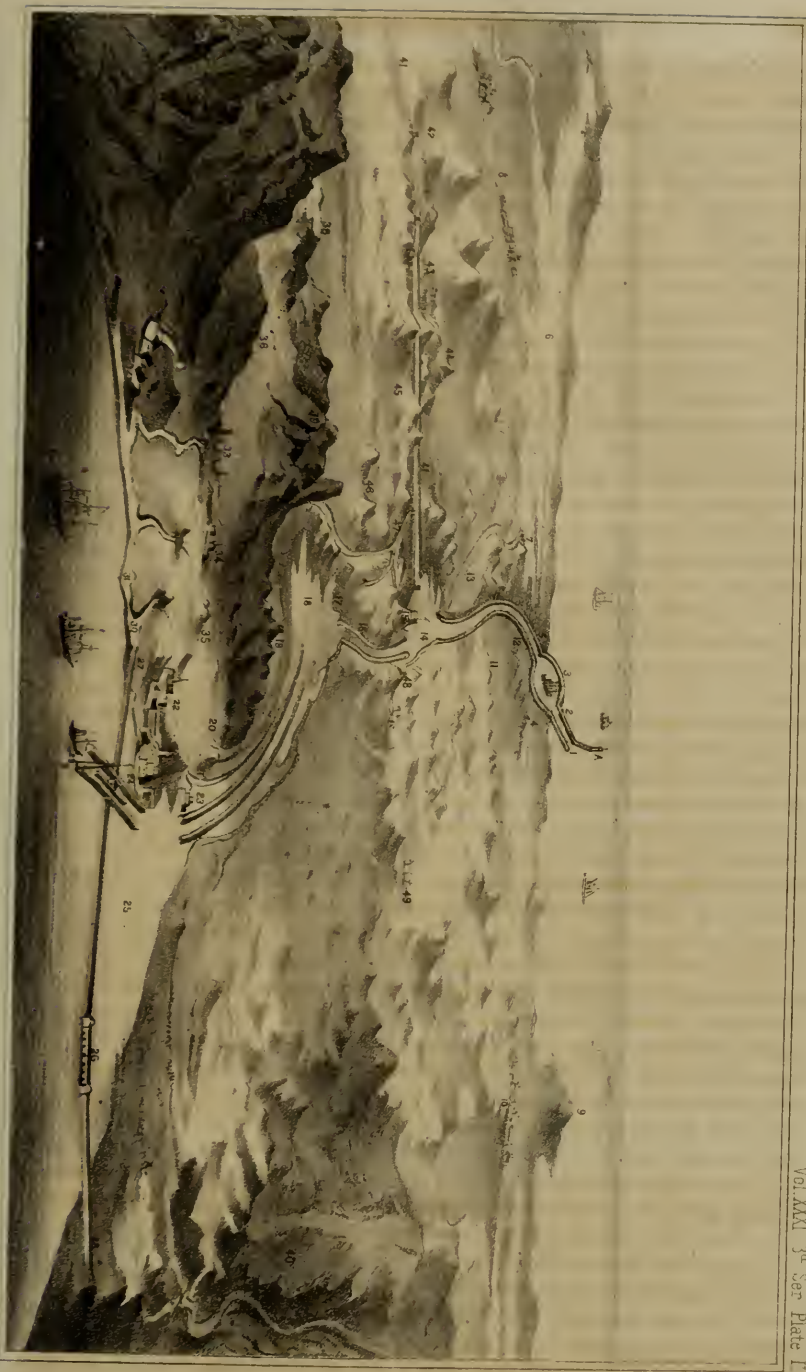
"The effect attained by this form of applying steel to resist pressure was found to be such that equal loads were sustained by one-third the weight necessary for elliptical springs of like capabilities and power.

"From the peculiar mode in which the rigidity and elasticity of the material was applied in these springs, although so very light, they were not liable to break or to be injured by any amount of force, if properly fitted: and the experience of upwards of seven years had proved that they were very economical for all railway purposes. The same experience had proved the unfitness of caoutchouc, or other substitutes for steel, for mechanical application, where great wear and tear had to be sustained; whilst the elliptical form of spring had many disadvantages, which were obviated by the direct action, the compactness, and the elasticity of the volute: and the saving effected by their adoption was not only in the first cost, which was great, but also in repairs, owing to the simple construction and application of the volute; whilst, in addition, much of the iron work necessary in fitting ordinary springs was saved."

It was stated that the volutes had been adapted not only to an immense number of locomotive engines, both abroad and in England, but also to tenders, wagons, trucks, and carriages, for bearing, buffer and traction springs; and in all cases with decided advantage, as to space and durability, over the ordinary elliptical springs. They were also now beginning to be employed as auxiliary springs for common road carts and wagons; and they were proved to be very valuable for many kinds of machines liable to sudden pressure, such as any unyielding substance passing between rollers which would otherwise almost inevitably be fractured.

Concurring in the almost universal opinion of the inadequate dimensions of the safety-valves being the most fruitful cause of explosions, and at the same time appreciating the practical difficulties attendant upon increasing the number of the area of the ordinary valves with the present system of weighting them, Mr. Baillie determined to try whether a safety-valve of large area could not be conveniently and steadily held down by a number of volute-springs of known power: this appeared to act extremely well; and in order to test the new system in comparison with the ordinary method, a safety-valve of 12 inches diameter, held down by seven volute-springs, was adapted to a locomotive boiler, on which there was also an ordinary valve of 3.6 inches diameter, weighted with the usual lever and spring balance. The boiler possessed an area of heating surface of 890 square feet; but, lest the cylinders should take too much steam, the engine remained stationary during the experiments, and the fire was urged by a constant jet of steam, of $\frac{1}{2}$ -inch diameter, into the chimney. The two valves were equally weighted to a pressure of 64 lbs. per square inch. The large valve was then fastened down, and in four minutes the pressure of the steam had increased to 105 lbs., when the small valve had risen $\frac{1}{12}$ of an inch, and the experiment was stopped, as the valve could not discharge the steam so fast as it was generated.

The small valve was then screwed down, and the large valve was set free: in four minutes the pressure had only increased from 64 lbs. to 76 lbs. per square inch, or 12 lbs., when the valve rose $\frac{1}{4}$ of an inch; and although the fire was powerfully urged for upwards of half an hour, the pressure of the steam could not be raised beyond 76 lbs., as the large



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area of the safety-valve allowed all the steam that was generated to escape freely.

These experiments were considered so satisfactory that the system of using volute-springs for the valves had been generally adopted for the boilers of locomotives of the Hungarian and Austrian railways, upon which Mr. Baillie was engaged.

In a recent letter to Mr. Kirtley, it was stated by Mr. Baillie, that eighty-one engines on the Hungarian and Austrian lines were carried upon volute-springs, and it was intended to alter all the others as opportunity offered. Double springs had been generally used for the middle bearing; but it was not now considered necessary, as some engines with single springs appeared to be quite as steady, and not to receive greater shocks than the others. The great point to be attended to was, that the volutes should not be overloaded, nor be screwed down too tightly. A volute of steel $5\frac{1}{4}$ inches broad and $\frac{7}{32}$ inch thick, should not be loaded with more than 20 cwt.s.—nor one of $4\frac{1}{4}$ inches broad and $\frac{7}{32}$ inch thick with more than 15 cwt.s.; and it would be still better if their loads were reduced to 18 cwt.s. and $13\frac{1}{2}$ cwt.s. respectively.

Great attention should be paid to the due and proportionate loading of the springs under an engine; and the engine driver should be strictly prohibited from altering the position of the nuts on the holding-bolts of the springs; as besides injuring the volutes, an undue weight must be thrown upon the other axles, and damage would ensue to the machine as well as to the rails.

With the ordinary flat springs, it was difficult to ascertain exactly what pressure was put upon them by altering the screws; but with the volutes, a certain law obtained, which rendered evident the absolute pressure to which they were subjected. Each spring was depressed a certain distance by a given weight—say, for instance, those of certain dimensions would be depressed $\frac{1}{4}$ inch by 6 cwt.; so that, if the spring was originally $8\frac{1}{4}$ inches high, when unloaded, it would, under a weight of 18 cwt., have been reduced to $7\frac{1}{2}$ inches in height; then, by trying and marking the trial weights upon the volutes and regulating them accordingly, there could not be any error in computing the pressure upon them.

The weigh-bridge, for ascertaining the exact weight upon each wheel, had been generally adopted with good effect; and to prevent the engine-man from altering the weight upon the springs, some thin washers were placed between the cross-bar and the collar upon each holding-bolt, which precluded the possibility of tampering with it. The effect of this regulation had been, that the engine-springs rarely required to be meddled with, and very few fractures occurred, unless the railway was in a bad state.

An illustration was given of the adaptation of the volute-springs to hydraulic safety-valves, for equalizing the pressure on water-mains, and obviating the injurious effects of the concussion caused by the oscillation of the column of water. This system, which had been introduced by Mr. Croker, for the Amsterdam water-works, was easily adjusted to a head of 170 feet, representing a pressure of 39.2 lbs. per square inch, or a total load of 1970 lbs. on the valve; it had been in use for six months, and might be perfectly relied upon.

The arrangement was very simple, consisting merely of a vertical branch of 8 inches diameter, springing from the horizontal main pipe of 6 ins. diameter. On the top of the branch pipe was fixed a valve and seat of gun-metal, so arranged that upon the lugs were fixed the wrought iron bolts holding the cross-bar, between the under side of which and the top of the valve was placed a volute-spring of about $2\frac{1}{2}$ tons pressure; the exact pressure was regulated by adjusting bolts provided with stop-nuts; and the apparatus could be accommodated to the required head with great facility and precision.

*Method of Carrying Railway Trains Over Mont Cenis.**

A gentleman of the name of Henfrey has taken out a patent, in Piedmont, for a very ingenious method of carrying railway trains over Mont Cenis, or any other similar mountain pass. The extreme simplicity of the means employed, rivals that of the celebrated discovery of the way to make an egg stand on end. A railway, of the usual description, will be laid down in a direct line from the bottom to the top of the ascent. The acclivity in the case of Mont Cenis will be from one in ten to one in twelve. Between these two rails a canal is to be dug, three feet nine inches in width, and about thirty inches in depth, which is to be lined and made completely water-tight with iron plates of the description called by engineers "boiler-plate." The motive power to be employed is a stream of water, about a foot deep, flowing—or rather rushing—down this canal. It is clear, therefore, that an abundant supply of water on the summit to be reached is a necessary condition of the scheme. Mont Cenis, however, affords every facility in this respect. On the outside of the railway another cogged rail will be laid down on either side. On the arrival of the train at the bottom of the hill, the steam-engine, which has so far brought it on its journey, will be exchanged for a machine of very simple and far from costly construction. In the middle of a frame, about the size of an ordinary steam engine without its tender, a water-wheel, adapted to the above described canal, will be fixed, having a diameter of twelve feet. On the same axis will be fixed two cogged wheels, to work in the cogged rails, of six feet diameter. With this apparatus it seems clear, that the descending stream must force the water-wheel to make revolutions towards the top of the hill, and to carry round with it the cogged wheels in the same direction. As the diameter of these is to be half that of the water-wheel, the rate of ascent will, of course, be half that at which the diameter of the water-wheel moves. It is calculated that the latter speed will be ten miles an hour, and the former therefore five. It is further calculated, that a machine of these dimensions will carry up the proposed acclivity a weight of from fifteen to twenty tons, or say from sixty to eighty passengers. Should it be required to transport a greater weight, as many other such engines may follow each other, at intervals of 150 feet, as may be required. Reckoning the ordinary present rate of traveling up the mountain at two miles and a half an hour, and considering that the direct rail will, between the

* From the Lond. Athenæum, December, 1855.

bottom and the top, traverse a space not more than half the length of the winding post-road, it will be seen that the ascent will be achieved in one-quarter of the time now occupied. For the *descent*, the water-wheel, moving through and against the stream, will act as a restraining force to moderate and regulate the speed. Experiments are now being made in the valley above Susa. In all this we see "no enemy save winter and rough weather." But, judging by our experience of the amenities of the hoary old mountain, we should fear that, unless the plan embraces some provisions against the obstinate foe, King Frost, the field would have to be abandoned to him for three or four months of the year.

*Steam on the Preston and Kendal Canal.**

We are glad to learn that the attempt made by Mr. Rawcliffe (the spirited agent to the Earl of Balcarres, in this town,) to introduce steam on the canal between Preston and Kendal, has answered the expectation formed of it. A screw boat is now at work; the engine, about 20-horse power, having two 8-inch cylinders, and occupying but little space on board, is placed in one boat, and four others are attached behind, forming what might be called a boat train. The quantity of coal conveyed each trip is about 200 tons, loaded in the five boats, and a speed of two miles per hour is maintained. This speed might be increased, we believe, did the depth of water in the canal permit it; but at present, if a greater speed is attempted, a swell of water is created in front of the boat, reducing the level of the canal at the bows so much as to cause the boat to scrape the bottom. By the old system, one horse dragged a boat of from 40 to 45 tons burden, at a rate of one mile and a quarter per hour. During the last fortnight, an extra new iron boat, capable of carrying 57 tons, has been attached to those previously towed by steam (making the five now used), and with this very large additional weight it has only made a difference in speed of three-quarters of an hour per day, and the addition of this extra weight has consequently retarded the boats almost imperceptibly. A new iron boat has just been built for the same purpose, to be worked by steam power. She is a twin paddle-boat. Two boats, each 60 feet long, having one central paddle working between them, and this arrangement prevents the usual swell which the ordinary river paddle-boats create. This steamer has already been tried on the canal, and is found to require less power to do the same work than the screw boat alluded to above. These experiments, combined with the substitution of iron for wood in the construction of the boats, open quite a new feature in the history of canal navigation.—*Preston Pilot.*

* From the Lond. Mechan. Mag., December, 1855.

AMERICAN PATENTS.

List of American Patents which issued from January 22d, to February 12th, 1856, (inclusive,) with Exemplifications.

JANUARY 22.

123. For a *Machine for Bending Plough Handles, &c.*; Benjamin F. Avery, Louisville, Kentucky.

Claim.—"The strap. Also, the combination and arrangement of the several devices constituting the machine."

124. For a *Method of Opening and Closing Farm Gates*; J. A. Ayres, Hartford, Conn.

Claim.—"1st, The employment and arrangement of the double-acting self-adjusting jointed treadle, in combination with the self-locking catches. 2d, Opening and closing the two parts of the gate and re-adjusting the driving boards by means of the simple arrangement of mechanism, consisting of weighted crank-shaft, elbow links, and connecting rods, arranged and combined with the two parts of the gate and the driving boards."

125. For an *Improvement in Flouring Mills*; Thomas Crane, Fort Atkinson, Wis.

Claim.—"Securing the bed stone within a hoop rising from a suitable bed plate, when the said hoop has an open annular space surrounding it, which is supplied with a discharging spout, and has a rotating hoop arranged and operating therein."

126. For an *Improvement in Eccentric Explosive Shells*; Wm. W. Hubbell, Philadelphia, Pennsylvania.

Claim.—"The combination of the head or segment of the solid sphere, with flat base uniformly around the fuze hole, with the segment of the hollow part forming a spherical-shell with flat based heads."

127. For an *Improvement in Cotton Seed Planters*; John M. Jones, Assignor to Newton Foster, Palmyra, New York.

Claim.—"The disk constructed with exit apertures, cavities, and ratchet; and, also, the vibrating rim with flexible arms thereon; the said disk being rotated upon said rim, in combination with, and in opposite direction to, the flexible arm."

128. For an *Improvement in the Arrangement of Tan Vats*; David H. Kennedy, Reading, Pennsylvania.

Claim.—"The arrangement of a tank, the tan vats, the main supply pipes, and their branches, whereby the tanning liquor may be caused to flow regularly through a series of vats from one to another without the aid of pumps, and any one or more of the vats may be insulated from the system of circulation for any required length of time without impeding a regular circulation of the tanning liquor through the rest."

129. For a *Machine for Dresssing Sticks to Polygonal Forms*; Joseph W. Killam, East Wilton, New Hampshire.

Claim.—"Planing at one operation sticks of timber of polygonal form straight and out of wind, without confining the same to a carriage by using the combination and arrangement of the feed rollers and the bed, and the guide plates and weights with the rotary cutter heads."

130. For an *Improved Riveting Machine*; Emmons Manly, Marion, New York.

Claim.—"The arrangement of the punch, lever, and mandril, in relation to the anvil and self-adjusting hammer head."

131. For an *Improvement in Mowing Machines*; Joseph S. Manning, Philadelphia, Pennsylvania.

Claim.—"Forming the teeth or fingers with a central rib, (closing the usual slot,) in combination with cutter plate and reciprocating blades, for the purpose of more effectually

preventing clogging of the cutter. Also, the device for elevating the cutter bar or beam, consisting of pulley or windlass, ropes, and straps passing over the shoulders of the horse."

132. For a *Method of Ventilating Railroad Cars*; Wm. H. Medealf, Baltimore, Md.

Claim.—"The passing of a current of air, the force of which is regulated by the motion of the car and a self-regulating bonnet, through a body of water, which water is retained within a certain space by a certain number of wire screens; the air thus freed from water, dust, cinders, &c., is carried directly into the car through registers or by pipes around the stove and out of the car by a similar apparatus (emptied of water) after the air has been used."

133. For an *Improvement in Machines for Hammering Leather for the Soles and Heels of Boots and Shoes*; Jean Pierre Molliere, Lyons, France; patented in France, July 22, 1853.

Claim.—"The hammering of sole leather upon a hard surface after it is cut into heel and sole strips, for the purpose of closing its pores without any displacement thereof, in order to render it water-proof by means of steel hammer heads of slightly rounded face attached to the hollow rods, which may be weighted at pleasure, and shall be so governed by a cam movement, that no two strike at the same moment, while they are kept by their shoulder piece from crushing the leather after it is hammered."

134. For an *Improvement in Sewing Machines*; John O'Neil, Xenia, Ohio.

Claim.—"The broad chisel-edged piece, which takes hold of several of the warp or weft threads, and thus feed along the material without piercing or penetrating the cloth, when such edge is of sufficient width to catch or hold the several threads of the fabric being sewed."

135. For an *Improvement in Grate Bars*; John T. Osborn, New Orleans, Louisiana.

Claim.—"Increasing the height of ordinary grate bars of furnaces, by an addition to their top of a piece having its sides concave and without any fags in its entire length."

136. For an *Improved Method of Regulating Velocity of Wind Wheels*; Francis Peabody, Salem, Massachusetts.

Claim.—"1st, The wind gate. 2d, The method of controlling the wheel by means of the rods and screw."

137. For an *Improvement in Seed Planters*; Freeman Plummer, Manchester, Ind.

Claim.—"The seed cap as formed by the slide, conductor, and hinge."

138. For an *Improvement in Means for Operating the Steam Valves in Blower Engines*; James P. Ross, Lewisburgh, Pennsylvania.

Claim.—"The cam yoke, in combination with the adjustable weights and counterpoise levers, or the mechanical equivalents of these several parts."

139. For an *Improved Method of Boxing Carriage Wheels*; Charles Schmitt, Union, Missouri.

Claim.—"A new and useful machine for boxing carriage wheels."

140. For *Improved Primers for Cartridges of Fire Arms*; Horace Smith, Norwich, and Daniel P. Wesson, New Haven, Assignors to "The Volcanic Repeating Arms Company," New Haven, Connecticut.

Claim.—"The combination of a copper or brass case, an iron or steel disk, with cork, or its equivalent, and fulminating powder."

141. For an *Improvement in Grain and Grass Harvesters*; John H. Manny, Rockford, Illinois.

Claim.—"In connexion with a dividing piece for throwing the grain inwards from the extreme ends of the cutters or platform, a recess or space, behind said space, into which a portion of the grain may afterwards drop and be cut, for the purpose of obviating the tendency to choke or clog at the ends of the cutters. Also, the intermediate piece between the tongue and the cutter beam, for the purpose of providing a yielding or elastic joint, not only at or about the line of the cutters, but also at the heel of the tongue. Also, in combination with the lever, having its fulcrum pivoted intermediately

between the tongue and the frame of the machine, the strap and hinged supporting piece, for the purpose of regulating the height of the cutters."

142. For an *Improvement in Harvester Cutter Bars*; John H. Manny, Rockford, Ill.

Claim.—"The tempered steel finger bar, by which the delivery of the cut grain or grass upon the stubble is facilitated, and other advantages."

JANUARY 29.

143. For an *Improvement in Means for Operating the Throttle Valve of Steam Engines*; Abel Bisbee, Chelsea, Massachusetts.

Claim.—"Raising and lowering the vibrating toe, by means of the lever, operated by the governor."

144. For an *Improvement in Shot Pouches*; Joseph T. Capewell, Woodbury, Conn.

Claim.—"My improvement in the construction of a cut-off, having the lower edge or bottom straight; also, having the vertical edges turned up (or over). Also, the mode of fastening the rings around the main tube or throat of the shot pouch."

145. For an *Improvement in Field Fences*; Thomas J. Carleton and Stephen Post, York, Ohio.

Claim.—"A fence constructed of rails, secured to each other, and supported at proper distances above the ground, by posts composed of iron rods, twisted alternately round each other and around the rails; and one, or both of the rods, bent down from the top of the fence, to brace it to the case in which the rods are fixed."

146. For an *Improvement in Locomotive Furnace Grates*; George R. Comstock, Mannheim, New York.

Claim.—"The simultaneous raising of the grate and opening of pipes at will, for aiding the combustion of fuel in the furnace, during the running of the engine, by the combination of the reciprocating plates or stop rod, and parts connected therewith."

147. For an *Improvement in Machines for Replacing Railroad Cars*; Henry A. De-graw, Piermont, New York.

Claim.—"The combination of the self-adjusting packing wedge, attached to an elastic or yielding rod, with the bars, operating levers, and gripping jaws, constructed and arranged for operation together, in such a manner, that while upon the depression of the hand lever, which effects the movement of the car, or locomotive wheel, the gripping jaws are made to firmly grasp the rail to secure a steady fulcrum, for the operation of the lever, the packing wedge follows up the movement of the wheel to retain it in the place to which it has been moved, and upon raising the hand lever, the gripping jaws are released, and the whole implement may be run forward on the rail, for a further joint action of the self-adjusting wedge and gripe of the jaws as a prop, to follow up the work repeatedly and progressively."

148. For an *Improvement in Brick Machines*; Louis T. Delassize, New Orleans, La.

Claim.—"The combination of the sectional pinion and spring-toothed crane, with the rock shaft and pressing rods."

149. For an *Improvement in Scaffolds*; Charles Foster, Philadelphia.

Claim.—"A scaffold, consisting of the combination of the adjustable uprights, the movable brackets for supporting the foot boards, and the horizontal adjustable ties; and also held or secured in a perfectly steady position near the building which is to be repaired, or painted, without direct contact with the wall of the same, by means of the jacks and the braces."

150. For an *Improvement in Telegraphic Registers*; Moses G. Farmer, Salem, Mass.

Claim.—"That modified combination of parts, by which the self-acting telegraphic repeater, the breaking, instead of the closing of the local circuit is made to close the main circuit, and by which, throughout, the breaking of the local circuit is made a substitute for closing."

151. For an *Improvement in Apparatus for Heating Buildings by Steam*; Stephen J. Gold, New Haven, Connecticut.

Claim.—"The automatic governing of the draft and the shutting off of the same, by

the forcing of water from the boiler, by pressure of steam—or in other words, establishing the hydraulic seal. Also, the automatic government of the valve, by the forcing of water from the boiler, by pressure of steam. The governing of draft valves by expansion of water being expressly disclaimed."

152. For an *Improvement in Universal Joint for Connecting Shafts, &c.*; John Hinkley, Huron, Ohio.

Claim.—"Connecting shafts when placed angularly with each other, by means of the universal joints, by which a rotary motion may be communicated from one shaft to the other."

153. For a *Mortising Tool*; Hazard Knowles, City of New York.

Claim.—"Combining in one instrument, a series of chisels, of the width required to give the desired form to the wood to be cut, when the said chisels are arranged in succession, on a line oblique to the line of motion of the entire series, and with gullets interposed, to receive and hold the wood cut by each chisel, until it passes through the thickness of the material to be cut—by which combination and arrangement, the desired form is given at one operation, by the breadth of the chisels, and by the inclination of the series to the line of motion of the cutting edge. Also, the employment of an instrument composed of the combined series of chisels, in combination with the jaws on which the wood to be mortised is placed, which jaws are to be adjustable, relatively to the line of motion of the said instrument, and the inclination of the series of chisels, as to sustain the under surface of the wood, outside of the form intended to be cut, and to act as resisting shears, in conjunction with the chisels, which finish the cutting of the desired form."

154. For an *Improvement in Pill Making Machines*; Noah W. Kumler, Cincinnati Ohio.

Claim.—"The combination of the adjustable plates, apron, pulley, and drum—and these, in combination with the grooved roller and segmental plate."

155. For an *Improved Apparatus for Stenciling Window Shades*; Daniel Lloyd, City of New York.

Claim.—"1st, Producing patterns on window shades, in which long or continuous lines form a prominent feature, by means of pairs of stencils of the full size of the design. 2d, The mode of registering the stencils, by use of the movable piece, in combination with the fixed stops, for the purpose of readily adapting the stencils to shades of various widths."

156. For an *Improvement in Mastich for Covering Walls*; Adolph C. Moestue, Kane County, Illinois.

Claim.—"The glazing of surfaces, previously coated with rosin or its equivalent, by a naked flame."

157. For an *Improvement in Grinding Mills*; Lucius Paige, Cavendish, Vermont.

Claim.—"Arranging and combining with a screw, one or more wheels and a hopper, whereby such mechanism is made to answer the purpose of a mill for grinding."

158. For an *Improvement in Machines for Cutting Flocks and Paper Stock*; Joseph N. Pitts, Blackstone, Mass.

Claim.—"The combination of the cylinders provided with spiral knives, cutters, attached to the adjustable and elastic or yielding bars, and the drum."

159. For an *Improved Punching Machine*; Rufus Porter, Washington, D. C.

Claim.—"The use of the double quadrant, in combination with the tappet, the sliding shaft, when the several parts are arranged and operated, in connexion with the fly-wheel."

160. For an *Improved Hinge*; George M. Ramsay, City of New York.

Claim.—"The anti-friction roller, in combination with a joint hinge."

161. For an *Improvement in Bee-Hives*; H. G. Robertson, Greenville, Tenn.

Claim.—"Making the joints hollow, and stuffing them with caustic lime, or other matter offensive to insects."

162. For an *Improvement in Machines for Clearing Snow from Railroad Tracks*; Riley Root and Samuel G. Holyoke, Galesburg, Illinois.

Claim.—"The arrangement of a rotary fan blower, provided with knives, and made sufficiently large to sweep the entire width of the track."

163. For an *Improvement in Screw Jacks*; Henry F. Shaw, Boston, Mass.

Claim.—"The 'screw-jack,' consisting essentially of the screw, plates, and double pawls."

164. For *Improved Chimney Cowl*s; Charles F. Thomas, Taunton, Mass.

Claim.—"Arranging the vane, so that it shall extend directly across the discharging aperture of the cowl, or ventilator, and divide such aperture. Also, constructing the vane of two wings, flaring from one another, as they extend from the cowl. Also, arranging each of the wings, so that it shall extend down below the discharging aperture of the cowl and from and around the external surface of the cowl."

165. For an *Improved Method of Attaching Teeth to Saw Plates*; Philos B. Tyler, Springfield, Mass.

Claim.—"1st, The hardened nib holders, attached to the saw plate, at each tooth, to hold a small cutting nib. 2d, The cutting nibs attached to the saw teeth, whether by means of the nib holder, or directly connected with the plate."

166. For an *Improved Device in Tree-nail Machines*; Elbridge Webber, Gardiner, Maine.

Claim.—"The construction of the traversing forming box of a flaring mouthed bit holder, combined with the slide, whose upper surface composes so much of the form box opening as lies below the plane of the bit seat, produced perpendicular, to which plane said slide is adjustable, for changing the size of the tree-nail."

167. For an *Improvement in Buggy Wagons*; Thomas Winans, Baltimore, Md.

Claim.—"The combination of bent bars and springs, to connect the fore and hind axles, support the seat, with both the requisite firmness and elasticity, and to permit the front wheels to pass under the seat, in turning short round."

168. For an *Improvement in Belt and Band Fastenings*; George D. Young, Plymouth, Massachusetts.

Claim.—"A clasp, for uniting the ends of a belt or band—consisting of the bottom plate, with its vertical studs, and the turning bottom, or its equivalent."

169. For an *Improved Soldering Iron*; Daniel Dod, Assignor to self, and Henry F. Read, Brooklyn, New York.

Claim.—"The combination of a hollow bit of copper, with movable centres of iron."

170. For an *Improvement in Machines for Cutting Mouldings on Marble*; Hiram L. Houghton, Assignor to Abel H. Grennel, Springfield, Vermont.

Claim.—"The method of cutting mouldings upon the edges of blocks, by the employment of the disk and the adjustable table top."

171. For an *Improved Cell Lock*; Edward Kershaw, Assignor to self, and Henry M. Hooper & Co., Boston, Massachusetts.

Claim.—"The combination of the bars, having notches at certain proportioned distances, operating in connexion with the studs on the cell door."

172. For an *Improvement in Flouring Mills*; Joseph Weis, Bordentown, N. J.

Claim.—"The longitudinal grooves between the dove-tailed steel pieces."

RE-ISSUES FOR JANUARY, 1856.

1. For an *Improvement in Ploughs*; Samuel Hulbert, Ogdensburgh, New York; patented September 20, 1853; ante-dated September 20, 1852; re-issued January 1, 1856.

Claim.—"Constructing a mould board and moulding part of the share of a plough, so that a horizontal line drawn at any height across their working side, shall describe a

convex arc of a circle, and any line drawn across its working side, at right angles to the base, shall also describe the convex arc of a circle, separately or connectedly."

2. For an *Improvement in Cotton Presses*; Nathan Chapman, Mystic River, Connecticut; patented August 8, 1854; re-issued January 8, 1856.

Claim.—"The recesses or slots in the hubs of the toothed wheels on which the chains that raise the follower work, for receiving the lower ends of the chains when wound up, and bringing the pressure nearer the centre of the bearings of the wheels."

3. For a *Machine for Composing and Setting Types*; William S. Loughborough, Rochester, New York; patented October 23, 1855; re-issued January 8, 1856.

Claim.—"1st, The composing wheel. 2d, The means above described for delivering the types from the various cells to the jaws of transits, or their equivalents, fixed to a wheel or other rotary apparatus. 3d, The construction and application of the transits, as described, or their equivalents, attached to a wheel or other rotary motion, to convey the types from the slides, or their equivalents, to the gally or composing chamber. 4th, The devices for effecting the delivery of the types from the cell of small js, and those cells which are similarly conditioned in case of italics. 5th, The construction and arrangement of the lever and its head. 6th, The construction and arrangement of the justifying bar, in combination with the cam ratch. 7th, The index, fixed to the bar, by which it is operated, in combination with the index plate. 8th, The application of the detent, operating as described. 9th, The construction and arrangement of the lever, in combination with the "rule" or line register. 10th, The tappet, constructed as described, so as to effect the horizontal and vertical changes of the lever. 11th, The detents, so applied as to retain the slides, when they are thrown back after delivering a type."

4. For an *Improvement in Machines for Washing Paper Stock*; Horace W. Peaslee, Melden Bridge, New York; patented January 23d, 1855; ante-dated September 20, 1854; re-issued January 8, 1856.

Claim.—"The employment of a wire gauze or reticulated cylinder with open ends, and placed with its axis in a horizontal or nearly horizontal position, and with its lower part revolving in a trough of water; but this I only claim when the said cylinder is provided on the inside with hooked or bent teeth, for the purpose of catching and elevating the paper stock in separate portions, to drain the water out of it, and drop it in the water, and thus subject it to the several operations required, as it is moved from end to end of the cylinder. Also, in combination with a reticulated cylinder armed with hooked teeth, and rotated in a trough of water, the employment of inclined curbs, at the delivery end of the cylinder, for the purpose of regulating the delivery of the paper stock."

5. For an *Improvement in Track Clearers for Grass Harvesters*; Abner Whitely, Springfield, Ohio; patented August 22, 1854; re-issued January 8, 1856.

Claim.—"The rolling cone, moving on the axis, at an acute angle to the finger piece, and furnished with a joint clearer, as described, and for the purpose of clearing a track, in the cut grass."

6. For an *Improvement in Machines for Threshing and Winnowing Grain*; Andrew Ralston, Middletown, Pennsylvania; patented February 21st, 1842; re-issued January 15, 1856.

Claim.—"1st, The peculiar construction in chaff screen, which consists of a thin plate of metal, punched with a semi-circular instrument for the purpose of producing semi-circular apertures, and at the same time leave the parts of the metal thus partly punched from said plate, overhanging said apertures, at an angle greater than that of the plate, for the purpose of allowing the grain to pass through said apertures, and at the same time prevent the chaff and straw entering them, and thereby preventing choking. 2d, the combination of the system of screens, the blower, and the elevators, for cleaning and conveying the cleaned grain to the granary, or other place of deposit."

7. For an *Improvement in Sewing Machines*; Thomas J. W. Robertson, Assignor to self, and Alfred E. Beach, City of New York; patented March 20, 1855; re-issued January 15, 1856.

Claim.—"1st, The combination of the spring clamp, with the feeding bar or dog, constructed, arranged, and operating together against the cloth on its one side or surface. 2d, The arrangement for effecting the feed, that is to say, setting the arm of the feed

finger at such angle to the table that the diagonal direction of the thrust will cause the reciprocating motion imparted to the upper end to produce, in combination with the table, a lateral motion thereon of the feed finger, as well as the requisite pressure for gripping and feeding the cloth."

8. For an *Improvement in Apparatus for Dissolving Silica*; Benjamin Hardinge, City of New York; patented May 8, 1855; re-issued January 22, 1856.

Claim.—"The method of taking the liquid from the upper part of the charge in the boiler or digester, containing the silicious matter and the solvents thereof, passing it through a heater, and discharging the vapor thereof in the lower part of the charge, when this is combined with a boiler or digester provided with stirrers for stirring the charge."

9. For *Improvements in Sewing Machines*; Allen B. Wilson, Pittsfield, Mass.; patented November 12, 1850; re-issued January 22, 1856.

Claim.—"Forming a stitch by each throw of the shuttle, and corresponding motion of the needle; that is to say, making one stitch at each forward, and another at each backward motion of the shuttle, this being effected by the needle in combination with the shuttle."

10. For *Improvements in Sewing Machines*; Allen B. Wilson, Pittsfield, Mass.; patented November 12, 1850; re-issued January 22, 1856.

Claim.—"The method of causing the cloth or the material to be sewed in a sewing machine, to progress regularly, by the joint action of the surfaces between which it is clamped, and which act in conjunction. 2d, Holding the cloth or other material at rest, by the needle, or its equivalent, in combination with the method of causing it to progress regularly, 3d, Arranging feeding surfaces, in such relation to the needle, that they, or one of them, shall perform the office of stripping the cloth or material from the needle, as it rises or recedes from it. 4th, So mounting and attaching one of the feeding surfaces to some other part of the machine, as that it may be removed or drawn away from the other surface at pleasure."

11. For an *Improvement in Grinding Mills*; Amory Felton, Troy, N. Y.; patented January 2d, 1855; re-issued January 29, 1856.

Claim.—"1st, In combination with the cylinder and concave, the cap, provided with spiral ribs on its under side, for carrying forward the ground material towards the discharge end, and thus to make room for that which follows, and prevent clogging and choking. 2d, In combination with the cylinder, concave, and cap, the fingers, for agitating the material, and causing it to pass more readily in between the cylinder and concave."

12. For an *Improvement in Harvesting Machines*; John Reily, Hart Prairie, Wisconsin; patented November 20, 1855; re-issued January 29, 1856.

Claim.—"1st, The retracting divider. 2d, The grain guard."

DESIGNS.

1. For *Hall Pendants*; Samuel B. H. Vance, Assignor to Mitchell, Bailey & Co., City of New York; patented January 1, 1856.

Claim.—"The configuration and arrangement of the several parts and ornaments combined as set forth."

2. For *Hall Pendants or Chandeliers*; Samuel B. H. Vance, Assignor to Mitchell, Bailey & Co.; patented January 1, 1856.

Claim.—"The design, configuration, and arrangement of the several parts and ornaments."

3. For *Perfumery Bottles*; Augustus E. Wetherill, Cincinnati, Ohio; patented January 8, 1856.

Claim.—"The ornamental design of bottle."

4. For *Cooking Stoves*; Garrettson Smith, Henry Brown, and Joseph A. Read, Assignors to James G. Abbott and Archilus Lawrence, Philadelphia, Pennsylvania; patented January 22, 1856; ante-dated December 31, 1855.

Claim.—"The design, configuration, and arrangement of the several ornaments in bas-relief, and mouldings, on the plate of stove 'Premium.'"

5. For *Portable Furnaces*; Garrettson Smith, Henry Brown, and Joseph A. Read, Assignors to A. E. Warfield, Philadelphia, Pennsylvania; patented January 22, 1856; ante-dated December 31, 1855.

Claim.—"The design, configuration, and arrangement of the several plates and ornaments thereon, constituting a new design for portable furnaces."

6. For *Portable Ranges*; Garrettson Smith, Henry Brown, and Joseph A. Read, Assignors to A. E. Warfield, Philadelphia, Penn.; patented January 22, 1856; ante-dated December 31, 1855.

Claim.—"The design, configuration, and arrangement of the ornaments in bas-relief, and mouldings on the several plates."

FEBRUARY 5.

1. For an *Improvement in Bell Stench Trap*; Charles H. Bush, Fall River, Mass.

Claim.—"Providing the said grating or perforated plate of the sink with a funnel neck or tube, arranged centrally over and in combination with the bell or cup, made separate or detached from the grating for operation together, as described, for greater convenience in the use, and better cleansing of the trap, with total exemption from escape of effluvia in the apartment wherein the sink is placed, under every use of the trap by the funnel, or otherwise."

2. For an *Improvement in Corn Dryers*; Solomon Bernheisel, Tyrone Township, Pennsylvania.

Claim.—"The perforated pipes, in combination with the hopper, placed above the hot air chamber, so as to allow the air to pass between the inner perforated pipe, and the smoke pipe, while the hot air from the chamber passes up between the outer perforated pipe, and the exterior pipe or casing."

3. For an *Improved Ore Washer*; William Ball, Chicopee, Massachusetts.

Claim.—"The trough, when constructed with the ledge, and operated in connexion with a head of water, kept above the level of said ledge."

4. For an *Improved Raking Attachment to Harvesters*; A. H. Caryl, Sandusky, Ohio.

Claim.—"Operating the rake, that is, the rod provided with teeth, by means of the weight and pulley, the weight and pulley being connected to the rod by chains, and otherwise arranged as described."

5. For an *Improved Photographic Plate Vise*; Levi Chapman, City of New York.

Claim.—"The arrangement of the jaw, with the piece between the slides, and between the cross piece, acted on by the crank piece, or its equivalent, when combined with the jaw, changeable in the grooves, in the sides of the trough."

6. For an *Improvement in Lugs for Cast Iron Shingles*; John Cook, Westmoreland, New York.

Claim.—"The projection, with the nail hole on the under side of the shingle, for fastening the same to the rib, either on its upper or lower edge at choice, and for securing the nail from the wet, thereby preventing it from rusting and becoming loose."

7. For an *Improvement in Pumps*; Edward N. Dickerson and Elisha K. Root, Hartford, Connecticut.

Claim.—"Two buckets working in pump barrels, so arranged that the column to be raised, passes through both in succession, in combination with the spiral cams, or their equivalents, so arranged as to move said buckets, with uniform velocity, and to maintain practically, a uniform and constant lifting action upon the water. 2d, Imparting to the column of water by means of a reciprocating pump, a constant and uniform flow, through the ascending main."

8. For an *Improvement in Heating Feed-water Apparatus for Locomotives*; Peter S. Ebbert, Chicago, Illinois.

Claim.—"The auxiliary pipe, so arranged in relation to that part of the main pipe, containing a valve, that a communication may exist between the water space of the boiler, and the interior of the feed-water pipes in the smoke stack, when the feed pump is not in operation."

9. For an *Improved Saw Set*; Joseph G. Ernst, York, Pennsylvania.

Claim.—"The use of the expanding arms, in connexion with the plate and screw nut, arranged and operated in the manner described."

10. For an *Improvement in Cutting Files*; Major H. Fisher, Sing Sing, New York, Assignor to Joseph A. Hyde, Bridgewater, Massachusetts.

Claim.—"The sliding and self-adjusting chisel holder, constructed and operating substantially as described."

11. For an *Improvement in Three Wheeled Vehicles*; Elisha S. French, Binghamton, New York.

Claim.—"The combination and arrangement at the rear of the vehicle, of the castoring swiveling wheel, in such connexion with the perch or body, that while in the forward run of the vehicle, the said wheel runs in a parallel course, central to the other two (advance) wheels, and at a considerable distance behind them, it, in backing the vehicle, is caused to occupy a like parallel and central position with its rim or tire, in direction of the travel, but in closer proximity to the fore wheels, and on the reverse side of the swivel, towards the front end of the vehicle, and out of the way as it were, whereby additional facilities are afforded for backing the vehicle in a crowded thoroughfare, and the other advantages specified are obtained."

12. For an *Improved Feed-water Apparatus to Steam Boilers*; Thomas Firth, Cincinnati, Ohio.

Claim.—"The arrangement of the pistons, beam, pins, (attached to the valve,) and spring, or their equivalents, for giving motion to the steam valve, for admitting steam to and from the steam cylinders and pipes attached thereto."

13. For an *Improved Bench Vise*; Thomas Gissinger, Alleghany, Penn.

Claim.—"The projection (g,) and the projections (1) and (κ,) arranged as described, and for the purposes set forth."

14. For an *Improvement in Machines for Making Rope*; Elisha Harris, Providence, Rhode Island.

Claim.—"The movable self-adjusting trumpet guide, as described."

15. For an *Improvement in Brick Presses*; Henry J. Hughes, Davenport, Iowa.

Claim.—"1st, The table actuated as described, or by any other equivalent means by which the bricks are discharged after being pressed, and by which they are borne away from the press-head. 2d, The specific arrangement for oiling the mould during its passage up and down over the head."

16. For an *Improvement in Hot Air Furnaces*; Samuel Macferran, Philadelphia, Pa.

Claim.—"1st, Connecting the inner end of the bottom plate of the space for supplying the furnace with fuel, a ring for supporting and holding together the segmental plates of the fire-pot, so as to enable said ring to be held firmly by its connexion with the plate, which is secured to the front part of the furnace. 2d, Arranging the adjustable horizontal plate having spaces in its edges, in which the heating pipes fit above the fire-pot, and capable of being raised and lowered for the double purpose of diverging the heat entirely around the said heating pipes, and in contact with the sheet iron radiating casing, and regulating the draft of the furnace, and in fact, converting into an airtight heater if desired."

17. For an *Improvement in Carriage Springs*; Richard Montgomery, City of N. Y.

Claim.—"The corrugated spring, when used in connexion with the elliptic spring, as described."

18. For an *Improvement in Weighing Scales*; S. S. Mills and M. Bissel, Charleston, South Carolina.

Claim.—"Connecting the scale beam with arms, two or more, and otherwise arranged

as shown, so that either of the weights on the arms may, when not in use, be placed in line with the fulcrum of the beam."

19. For an *Improvement in Flour Bolts*; Stephen C. Mendenhall, Richmond, Ind.

Claim.—"1st, The direct and positive expansion and contraction of the valves, between fixed and varying points. 2d, The combination of the expanding and contracting valves with the cords, pulleys, drums, and indicators, or their equivalents."

20. For an *Improvement in Fire Pokers*; George R. Moore, Mount Joy, Pa.

Claim.—"The arrangement, or any of their equivalents, by which the several motions of the poker are obtained; also, the arrangement, or its equivalent, for contracting the handle of the poker at pleasure."

21. For an *Improvement in Lanterns*; Francis Morandi, Boston, Massachusetts.

Claim.—"The funnel, applied to the lantern, in the manner set forth."

22. For *Improved Fastenings of Hinges for Daguerreotype Cases*; Samuel Peck, New Haven, Connecticut.

Claim.—"The combination of the metal straps or supports, with the material of the case, when the same is plastic, so as to strengthen the case and form a secure fastening for the hinges."

23. For *Improved Metallic Pens*; Myer Phineas, City of New York.

Claim.—"The spring, when placed under the upper side of the pen, and so constructed and arranged as to serve the two-fold purpose described."

24. For an *Improvement in Oscillating Engines*; Juan Pattison, Brooklyn, N. Y.

Claim.—"The arrangement of parts, viz: the arched steam pipe, saddle hollow valve, and chest, for the passage and distribution of steam on cylinders of oscillating steam engines."

25. For an *Improvement in Harvesters*; B. F. Ray, Baltimore, Maryland.

Claim.—"1st, Providing the main or driving wheel of reaping and mowing machines, with a stationary guard plate. 2d, The slide bar arranged in the said horizontal plane, with, and perpendicular to, the axle of the driving wheel of reaping and mowing machines, in combination with the bell crank, for the purpose of giving direct and positive motion to the cutting apparatus, when arranged obliquely to the line of draft. 3d, Forming in the sliding bar a slot for the reception and operation of the bell crank."

26. For an *Improvement in Saw Mills*; John S. Snider, Lancaster, Ohio.

Claim.—"Such construction of the scale wheel and its combination with the large cog wheel, that the position of the lever when on its rest, will be always zero, and that the log may be moved at both its ends equally any required distance by raising its lever from its rest, and counting one-eighth of an inch, or a different fraction, according to the cast of the wheels for each cog that the pawl may pass over, and pressing the lever down again upon its rest, when the requisite distance is obtained, so that the setting of the log requires no calculations or reference to a scale, and may be done with perfect accuracy by the ear, or by the eye, and it is thus set at both ends by a single scale wheel, and a single pawl, and thus set necessarily exactly alike at both ends, which is not the case where the ends are set each by its separate framing. Also, the combination of wheels which are so adjusted as to effect the abovenamed objects, and also, to give greater power to the lever in moving heavy logs and more accuracy in adjusting them, as the log is thus made to move slow in proportion to the motion of the lever, and is not subject to be put out of its place by its own momentum, or by the spring of the rods. Also, in this construction and combination, the journal, and the pinion wheel, and scale wheel are cast together, and the rod passes through the journal and moves with it, so that the lever when pressed down moves the pinion wheel, which gives motion to the wheel which moves the head-block slide, and at the same time the journal moves the rod, and by it the tail-block slide, so that the rod communicates motion to the tail-block slide only, and is not put to the strain requisite to move both slides, and with them both ends of a heavy log."

27. For an *Improvement in Sewing Machines*; Alfred Swingle, Assignor to Elmer Townsend, Boston, Mass.

Claim.—"As a tension apparatus, the combination of a rotary grooved roller and a pressure roller, operating by means of a spring, or its equivalent, as specified; the same when a wax thread is used, producing advantage substantially as stated."

28. For an *Improved Mode of Constructing Cast Iron Buildings*; Harriet V. Terry, Administratrix of William D. Terry, deceased, Boston, Mass.

Claim.—"Forming cast iron hollow walls for buildings, by means of the combined use of the boxes, plates, and tie-pieces, provided with rebates and tongues for firmly uniting them together."

29. For *Improved Alarm Locks*; S. J. Frank, Guilford Centre, New York.

Claim.—"The use of the spring and rod when used in connexion with the plate, arranged and operated as set forth."

30. For an *Improvement in Making Wrought Iron Shafts*; Otis Turfts, Boston, Massachusetts.

Claim.—"Constructing large wrought iron shafts with pieces separately wrought and fastened together."

31. For an *Improvement in Machines for Softening Leather*; John B. Wentworth, Lynn, Massachusetts.

Claim.—"The combination of the roller by the rotary boarder, and the bar or concave, arranged and made to operate together. Also, the combination of the holding and draft mechanism rollers, with the boarding mechanism or rollers, the boarder and concave or bars, as specified. Also, the napping or filling mechanism, (or roller and bed,) in combination with the boarding mechanism, or the holding and feed rollers thereof. Also, combining with the movable table or bed, the rollers and bed, so that they may be moved simultaneously by either, towards or away from the boarder, the bed, and rollers. Also, when the boarder is made of a series of separate rubbers, springs, and holding frame, applying the sectional rubber to the frame, by means, viz: by a bar, and movable end, whereby the rubbers may be either detached from the frame, or maintained within it."

32. For an *Improvement in Grain and Grass Harvesters*; Abner Whitely, Springfield, Ohio.

Claim.—"Constructing the machine, that the driver is enabled, while the team is in motion, and the master wheel shaft being rigidly connected with the main frame, to change the angle of the fingers and cutters without moving the finger bar from the ground."

33. For an *Improvement in Belt Fastenings*; Abner Whitely, Springfield, Ohio.

Claim.—"The hook made as described."

34. For an *Improved Movement for the Doctors of Calico Printing Machines*; John Standing, Fall River, Mass., Assignor to self, and James Baraudale, Providence, Rhode Island.

Claim.—"The combination of the eccentric, the crank, the connecting rod, and lever, so applied to the shaft of the doctor, and made to operate the doctor."

35. For an *Improvement in many-chambered Breech Loading Cannon*; Charles C. Terrel, Shultsburg, Wis., Assignor to self, and Samuel Crawford, Mineral Point, Wisconsin.

Claim.—"1st, The combination of lock lever, the wedge and the two, in any manner, for the purpose of forcing up and drawing back the breech to and from the barrel. 2d, The priming tube, combined with the stationary priming magazine to take a new priming therefrom, every time the position of the breech is changed, by attaching it to the lock lever, furnishing it with a wedge or inclined projection 14, to open the valve of the magazine when the lever is raised to unlock the breech. 3d, The combination and arrangement of the hammer, trigger, and main-spring, with a lock lever, which is employed to lock and unlock the breech to and from the barrel."

36. For an *Improvement in the Mode of Attaching Composition Soles to Boots and Shoes*; John W. Wimley, Assignor to self, and Washington H. Penrose, Philadelphia, Pennsylvania.

Claim.—"The use of the staples, for the purpose of attaching composition soles to boots and shoes."

37. For an *Improvement in Writing Desks*; Charles H. Bergmann, City of N. Y.

Claim.—"Constructing the upper box of writing desks with adjustable or expanding sides."

FEBRUARY 12.

38. For an *Improvement in Machinery for Cutting Sand Paper*; William Adamson, Philadelphia, Pa.; ante-dated August 12, 1855.

Claim.—"The arrangement and combination of the slitting drums, in the manner and for the purpose set forth."

39. For an *Improvement in Scissors*; John Allender, New London, Conn.

Claim.—"Making or providing arms to the fulcrum, to vibrate with, and act upon each blade, some distance from the fulcrum, to hold and keep their cutting edges in contact with each other."

40. For an *Improved Method of Tonguing and Grooving Tapering Boards*; B. J. Barber, Balston Spa, New York.

Claim.—"The movable bed, with shaft and cutter attached, said bed being operated as described."

41. For an *Improved Wrench*; William Baxter, Newark, New Jersey.

Claim.—"Adjusting and securing the jaws of a diagonal wrench by means of the screw and joints."

42. For an *Improvement in Power Looms*; Erastus B. Bigelow, Boston, Mass.

Claim.—"The combination of the tension roller, the regulating rod, and the brake or holding lever, when co-operating. Also, regulating the action of the delivery motion by the combined action of the tension roller (or its equivalent), the regulating rod, the pawl or feeler, and the series of catches or stops. Also, the method of holding the tension roller (or its equivalent), whereby the regulating rod *l*, or its equivalent, is gripped. Also, the mode of constructing the brake or holding lever, and combining it with the cam, whereby the said holding lever is made to do the double duty of turning the let-off motion shaft, and holding the tension roller, or its equivalent, and whereby also the apparatus which regulates the delivery motion is made to act thereon when the shed is open and the tension roller at rest."

43. For *Machines for Boring and Turning Wood*; Felix Brown and Adolph Brown, City of New York.

Claim.—"The support, guiding the extreme end of the boring tool, said support being acted upon by a cam in connexion with springs or weights, in such a manner as to remain stationary, until the boring tool has some little distance entered the wood, and is then made to go backward, in proportion as the wood is pressed forward. 2d, The arrangement and manner of working either the fixed knife or the revolving saw, for the purpose of cutting off the finished work. 3d, The arrangement and manner of working the tools in connexion with the movable slides, attached to the fixed supports, acted upon by their respective cams."

44. For an *Improvement in Ploughs*; John Clark, Washington, D. C., and G. W. N. Yost, Pittsburgh, Pennsylvania.

Claim.—"The revolving share cutters attached to the mould board, in combination with the bearing plate or strap, and the extension of the land-side, or the equivalents of said bearing plate, and extension of said land-side, for the purpose of securing the free and certain revolution of the series of revolving share cutters."

45. For an *Improvement in Valves and Exhaust Passages of Steam Engines*; Chas. W. Copeland, City of New York.

Claim.—"The manner of increasing the area of the passages for escaped steam, by

means of bars or their equivalents, making part of the valve acting in conjunction with additional apertures or ports in the seat."

46. For an *Improvement in Signals for Vessels*; W. P. Craig and William R. Rightor, Newport, Kentucky.

Claim.—"A range of lights placed in the forward part, and in the longitudinal centre of a vessel, the foremost light being the lowest, and the following ones rising in succession above it, so as to present to an observer in or near the line of its course, a range of lights, which is either vertical, or is directed obliquely to starboard or larboard, according to the course of the vessel."

47. For an *Improved Method of Regulating the Feed Gates for Mills, &c.*; Clement Dare, Cincinnati, Ohio.

Claim.—"The combination of the floats, rods, beam lever, and sliding bar, and these in combination with the cam lever, shaft, levers, and rods, or their equivalents, for operating the gate."

48. For a *Rotary Planer for Felloes*; C. H. Denison, Green River, Vermont.

Claim.—"The combination of the rotary bed, cutter head, and cutter bar."

49. For an *Improvement in Oil Cans*; Levi S. Enos, Orlean, New York.

Claim.—"The compact arrangement with each other of the air tube, the discharging tube, the thumb-piece, the spring, the valve rod, and their movable cover of the can, which enables the said operating parts to be easily withdrawn from the can, for examination and repairs, and as easily replaced again for service."

50. For an *Improvement in Devices for Removing Incrustations of Boilers*; William E. Everett and M. Minthorne Thompson, City of New York.

Claim.—"The method of softening, or softening and removing the deposit upon boilers commonly known as scale, namely, by exposing the same to the action of steam."

51. For an *Improved Adjustable Carriage Seat*; David N. Flanders, South Royalton, Vermont.

Claim.—"The additional revolving seat, hinged upon the bed piece, so that it will turn and assume the two positions described, and thus make the carriage convenient for the accommodation of two or three passengers."

52. For an *Improvement in Railroad Car Axle*; P. G. Gardiner, City of New York.

Claim.—"My improved car axle, composed of a sheet of metal wound into a tubular form, with its ends welded to solid journal pieces."

53. For an *Improvement in Gas and Steam Cooking Apparatus*; John S. Gالياher, Jr., Washington, D. C.

Claim.—"1st, The construction of gas cooking apparatus, formed as skeleton frame plates, having ventilating slots, or equivalents, and the arrangement therewith of a series of longitudinal and transverse jet tubes or pipes in tiers, together with the compound tubular valve pipes, and the combination of the above devices, with detachable drawer-like or baking apartments. 2d, The construction of the central reservoir heater, and the steam boiler sheet device, as described, and in application and use as set forth. 3d, The compound suspension griddle device, and the ventilating diaphragm vessel, as described. 4th, The air supply bellows, or pump device, and the application and use of the same, as described."

54. For an *Improvement in Sticking Pins in Paper*; Thaddens Fowler, Waterbury, Connecticut.

Claim.—"The use of the form for separating, arranging, and spacing the pins when combined with the paper holder, for the purpose of transferring the pins to the prepared paper ready for sticking, when both are constructed, used, and made to produce the result. Also, the combination of the paper holder with the frame, when constructed, arranged, and used for inserting the pins into the prepared paper."

55. For an *Improvement in Seed Planters*; Robert Gebby and William Gebby, New Richland, Ohio.

Claim.—"1st, Constructing a corn planter with compound or double graduating feeding valve rod device, having a stirrer pin or spur, and combined in operation with the

actuating lever device, formed with the trigger, and spur, and spring hook, or catch device. 2d, The skimmer fender formed with a hinged flap or pressure plate and adjusting rod."

56. For a *Lubricator*; William Gee, City of New York.

Claim.—"A glass cylinder, as described, protected by a brass or other metallic cylinder, with openings to see the oil, and the tube passing up through the oil, which, by radiating its heat derived from the hot steam, keeps the oil in a liquid state under all temperatures. Also, the method of preventing accidents of the glass breaking, by the elasticity of the india rubber above and below the edges of the glass lubricator as packing, as well as the diaphragm of india rubber, as described, the whole in combination as a lubricator or to supply and regulate the flow of oil, and, by sight, enable the person attending to know when the oil or lubricating material is exhausted, and by the method described. By the diaphragm, I do away with the necessity of having ground metallic surfaces which are always getting out of order; this lubricator will answer for supplying vacuum by opening the cock, the air passing up the tube above the oil, which forces the oil out, and making a vacuum lubricator, which I include as part of my claim."

57. For an *Improvement in Power Looms*; Elijah Hall, Rochester, New York.

Claim.—"Locking and unlocking the reed by means of sliding bolts applied to the back of the lay, behind the reed, and operated by connexions with the connecting rods by which the lay is driven."

58. For an *Improved Hand Press for Stamping Letters, &c.*; Anson Hatch, Forrestville, Connecticut.

Claim.—"So combining the arm which carries the stamp, plate, or form, with the cam, as that by vertical pressure on said arm it shall move over the inking apparatus horizontally or nearly so, to be inked, and then descend vertically on to the bed, to give the impression, and in returning, pass above the inking rolls, so as not to touch them."

59. For an *Improvement in Condensing Steam Engines which are used for Pumping*; Birdsill Holly, Seneca Falls, New York.

Claim.—"Leading the eduction steam pipe of a steam engine into the suction pipe of a force or lift pump, whereby the condensation of the steam is effected and a partial vacuum produced without a separate condenser and air pump, and in this, engines employed wholly or in part to raise water without any additional expenditure or loss of power to raise the water to effect condensation."

60. For an *Improvement in Cotton Seed Planters*; J. L. Horn, Edgecomb County, North Carolina.

Claim.—"The arrangement of the back and front guards, in combination with the distributing wheel, provided with the flanches, and chargers placed at proper intervals, so that no seed can escape below the horizontal line, except at the proper and lowest point immediately in rear of the opener."

61. For an *Improved Method of Hanging and Adjusting Circular Saws*; Westel W. Hurlbut, Utica, New York.

Claim.—"1st, The arms as connected with the bearings and supported by the pins or centres, in connexion with the slide. 2d, The moving of the saw, either sideways or diagonally, by the use of the slide and the bolts, or their equivalents."

62. For an *Improved Elevator for Puddlers' Balls*; Solon S. Jackman, Lock Haven, Pennsylvania.

Claim.—"The use of the pulley, lever, and brace, in connexion with the stem or supporter and tilt plate."

63. For an *Improved Wrench*; Ferdinand Keehnold, Bridgeport, Connecticut.

Claim.—"The jaws and lever, as constructed, operating in connexion with the ratchet bar."

64. For an *Improvement in Steam Condensers*; James T. King, City of New York.

Claim.—"A condensing tank having a vertical partition of any desirable depth, with the inlet steam pipe and a vacuum valve upon one side of the partition above the water,

and the escape steam pipe on the opposite side of said partition, so that the steam before it can escape, must, by its pressure, force the water down one side of the partition and pass up through the water in the other side."

65. For an *Improvement in Sealing Preserve Cans*; R. W. Lewis, Honesdale, Pa.

Claim.—"The combination of the projecting ribs with the cap, constructed, combined, and operating substantially in the manner specified."

66. For an *Improvement in Porte-Monnaies*; C. Lindner and C. Hoffmann, City of New York.

Claim.—"The application and manner of connecting the inside of the porte-monnaie elastic bands, or india rubber cords, or springs passing through the joint to the inside, so as to be able to attach the same to the finger."

67. For an *Improved Diaphragm Pump*; John L. McPherson, Clinton County, and Jacob O. Joyce, Cincinnati, Ohio.

Claim.—"The application to pistons of pumps of a corrugated diaphragm, which admits of greater length of stroke without overstraining the material. Also, in combination with a corrugated diaphragm, the flaring or rounded followers, so that they will approach and take up the folds of the diaphragm in accordance with the length of the stroke given to the piston rod. Also, the wedge-shaped valve, which lies loose in its seat, and rocks on its rounded base to open or close passages."

68. For an *Improvement in Wick Holders for Argand Lamps*; E. Moellen, Newark, New Jersey.

Claim.—"Holding the wick and pressing it outwardly against the wick tube, in the manner set forth."

69. For an *Improved Wrench*; Elisha P. Newton, Albany County, New York.

Claim.—"The arrangement of a semi-screw thread, cut or counter-sunk in the shank, and the semi-screw threaded stop or catch for working therein, by which means, finer threads may be used and the movable jaw be brought closer up to the nut, and the stop or catch removed out of the way of the action of the wrench, they being arranged and operating in the manner described."

70. For an *Improvement in Grain Harvesters*; Job Phillips, Harrisburgh, Pa.

Claim.—"The self-adjusting platform hinged at front, and so governed in its motions at the rear of the short arm of the regulating side lever, or equivalent thereof, as to maintain a fixed distance of the rear part from the ground, while the front part is raised or lowered by the adjusting levers."

71. For an *Improvement in Ships' Compasses*; John Prime, Washington, N. C.

Claim.—"The method of constructing the cover of compass boxes by inserting the metallic ring within the rim of the glass with a band of india rubber or other elastic material between, to compensate for the unequal expansion and contraction."

72. For an *Improved Method of Extinguishing Fires*; Lea Pusey, Philadelphia, Pa.

Claim.—"The adaptation of the water spouts of buildings to the purpose, by means substantially the same as those described."

73. For *Breech Loading Fire Arms*; William H. Robertson and George W. Simpson, Hartford, Connecticut.

Claim.—"The sliding socket breech constructed and operated in the manner described. Also, the flexible spring check to prevent the passage or escape of gas in breech loading fire arms."

74. For an *Improvement in Cultivator Teeth*; C. H. Sayre and G. Klink, Utica, New York.

Claim.—"So constructing a cultivator tooth, that when made of thin or sheet metal, a part thereof shall form a tubular shank, whereby said tooth may be drawn up and securely attached to the frame."

75. For *Improved Envelopes for Bottles*; John Luther, Coblenz, Prussia; patented in England, August 29, 1851.

Claim.—"The combination of mechanism and the making of envelopes for bottles, as described."

76. For an *Improved Safety Spring Coupling*; Edwin F. Shoenberger, Marietta, Pa.

Claim.—"The shape and construction of the coupling, so that the shafts of the carriage can be attached to the axle by merely dropping the ends downwards into the boxes, in a vertical position, and their combination with the spring to prevent noise or rattling."

77. For an *Improvement in Fluing Blast Furnaces*; Christian Skink, State Lick, Pennsylvania.

Claim.—"Applying and introducing common salt as a flue or solvent, or its equivalent, into blast furnaces at the tuyere or any point below the tunnel head."

78. For an *Improved Bolt Machine*; Timothy F. Taft, Fitchburg, Massachusetts.

Claim.—"1st, The two side punches operating simultaneously and equably upon the opposite sides of the bolt, in combination with the intermittent rotary motion of the bolt holder for the purpose of finishing the bolt head with its centre in the axis of the shank. 2d, The forward and backward motion of the bolt holder, when the rod which ejects the bolt, is supported at a point in advance of that on which the bolt holder vibrates, for the purpose of ejecting the finishing bolt."

79. For an *Instrument for Grating Green Corn*; Benjamin Taylor, Philadelphia, Pa.

Claim.—"The flat or concave piece of wood or metal with its opening scraper and one or more rows of spikes, the whole being arranged in the manner set forth."

80. For an *Improved Machine for Folding Paper*; Thomas Thompson, Niversville, New York.

Claim.—"The forming block, in combination with the rollers, so constructed and arranged, as to draw the material to be folded, over said block and fold it."

81. For an *Improved Oil Box for Axles with Conical Journals*; William D. Titus, Brooklyn, New York.

Claim.—"Constructing the cone or cones made close with an internal oil or grease chamber around a cylinder or tube forming the centre part longitudinally of the cone, and providing the said cone on its periphery, at opposite ends and on reverse sides, with slices or openings."

82. For an *Improvement in Clothes' Clamps*; William H. Towers, Philadelphia, Pa.

Claim.—"Forming slits at the upper portion of the clothes' clamps in such a manner, as to give an increased degree of elasticity to the upper portion of the jaws, between which the clothes are clamped, and enable said jaws to be opened sufficiently to admit the clothes and line between the grooves in the same, and to detach them therefrom, without scraping the clothes with the sides of the lower slit, by pressing the prongs formed by the upper slit together."

83. For *Cutter Heads for Planing Machines*; Loison D. Towne, Worcester, Mass.

Claim.—"The clamping or holding of the cutters between the brace and sides of the cutter head by means of the conical or wedge-shaped form of the plug and braces, or their equivalents, and whether said head be solid or made in two or more sections."

84. For an *Improvement in Railroad Switch*; James Whitcomb, Detroit, Michigan.

Claim.—"The enlargement for the long switch rail, when connected with a short switch bar."

85. For an *Improvement in Railroad Car Couplings*; S. W. Wood, Washington, D. C.

Claim.—"Constructing the buffers of railway cars in such manner, that the coupling rod may be dropped into its place from the upper surface or sides, said connecting rod consisting of a single piece of wood or metal being independent of, and not in any way fastened to the buffers, while it is retained in position by its own gravity."

86. For an *Improvement in Grain and Grass Harvesters*; George W. N. Yost, Pittsburgh, Pennsylvania.

Claim.—"Combining with the cutter bar of harvesters a series of friction rollers, when said rollers are kept constantly pressed down on the cutter bar by means of springs."

87. For an *Improvement in the Construction of Mustic Roofing*; C. C. Hoff, Albany, Assignor to E. P. Russel, Manlius, New York.

Claim.—"Preparing the canvas with the soluble and earthy matters in the manner set forth, and then covering the same with tarry resinous material and carbonaceous compound, in the manner set forth."

88. For an *Improved Method of Concaving Circular Saws*; James M. Kern, Morgantown, Virginia.

Claim.—"The making of a dish-shaped saw from a flat circular saw plate, by cutting away a portion of the interior of the plate, withdrawing a portion of the remaining metal into the spaces thus cut away, by which the desired concavity may be attained without cutting out to the periphery of the plate."

89. For an *Improvement in Pegging Boots and Shoes*; Alfred Swingle, Assignor to Elmer Townsend, Boston, Massachusetts.

Claim.—"The new arrangement of the cutting knife with respect to the peg wood carrier and the peg receiver, so as to operate against the side of the peg wood, and cut into it from side to side. Also, arranging or combining with the cutting knife and the handle, as described, a spring stop or catch, so applied as to operate and retain the knife in position to shut off communication between the feeding trough and the peg receiver under circumstances as stated. Also, arranging in front of the peg receiver and front of the knife a waste receiving and discharging chamber or mouth, the same being made to operate as specified."

90. For an *Improvement in Potato Planters*; Charles Morgan, Assignor to Samuel Emlen, Philadelphia, Pennsylvania.

Claim.—"The form and plunger, with its projection, in combination with the hopper, said fork and plunger being operated simultaneously."

91. For an *Improvement in Caldrons*; Henry Neusham, Baltimore, Maryland.

Claim.—"Constructing a caldron by giving the bottom thereof an arched form in the manner described."

92. For an *Improved Gearing for Feed Rollers of Planing Machines*; Charles Burleigh, Assignor to the Putnam Machine Company, Fitchburg, Massachusetts.

Claim.—"The toothed links constructed and operating in the manner set forth."

LAW REPORTS OF PATENT CASES.

For the Journal of the Franklin Institute.

Reaper Case.

C. H. M'CORMICK vs. J. H. MANNY *et al.*

The plaintiff's first patent for a reaping machine, being dated in 1834, has expired, and whatever invention it contained, now belongs to the public.

Improvements were made by M'Cormick in reaping machines, for which, in 1845, he obtained a patent, and in 1847, a patent for a further improvement, which last patent was surrendered and re-issued in 1853.

A machine may consist of distinct parts, and some, or all of those parts may be claimed as combinations.

In such an invention, no part of it is infringed unless the entire combination or the part claimed shall have been pirated.

In his patent of 1845, for improvements in the reaping machine, the plaintiff claimed the combination of the bow **L**, and dividing iron **M**, for separating the wheat to be cut from that which is left standing, and to press the grain on the cutting sickles and the reel. The defendants' wooden divider does not infringe that claim of complainant's patent, which embraces the combination of the bow and dividing iron.

Where the plaintiff's patent calls for a reel-post set nine inches behind the cutters, which is extended forward and connected with the tongue of the machine, to which the horses are geared, it is not infringed by a reel-bearer, extending from the hind part of the machine, and sustained by one or more braces. The only thing common to both devices, is the supporting the end of the reel nearest to the standing grain. In their combinations and connexions, and in everything else the devices are different.

The invention embraced in plaintiff's patents of 1847 and 1853, was not a raker's seat, but it was the improvement of his machine, by which it was balanced, and the shortening of the reel, so that room was made for the raker's seat on the extended finger-bar. This being his invention and claim, to this his exclusive right is limited.

Had he claimed generally, a seat for the raker, the claim would have been invalid by reason of the prior knowledge and use of the raker's seats in reaping machines.

M'Cormick's raker's seat, patented in 1847, was new in its connexion with his machine, but his invention did not extend to a raker's seat differently arranged.

Manny's reaping machine does not infringe either of M'Cormick's patents. The divider and reel bearer used in Manny's machine, being different in form and principle, do not infringe M'Cormick's patent of 1845.

The stand or position for the forker, invented and patented by John H. Manny, is a new and useful improvement, and different in form and principle from M'Cormick's patents of 1847, and 1853.

This was a bill in Chancery, filed in the Circuit Court of the United States, for the Northern District of Illinois, by Cyrus H. M'Cormick against John H. Manny and others, charging them with infringement of his patents for improvements in the reaping machine, dated January 31, 1845; October 23, 1847; re-issued in May 24, 1853.

The defendants filed their answer, setting up various grounds of defence, but relying chiefly on the defence that the reaping machines manufactured and sold by them at Rockford, Illinois, under the name of Manny's reaper, differ in form and principle from the improvements, patented by M'Cormick, and that the raker's stand or position was an improvement, invented and patented by John H. Manny. Issue being joined, a large volume of testimony was taken, showing the state of the art of making reaping machines before and after the date of M'Cormick's patents. The cause standing for final hearing on the Bill, Answer, Exhibits, and Testimony, it was, by agreement of counsel, heard at Cincinnati, in September, 1855, before the Honorable John McLean, Circuit Judge, and the Honorable Thomas Drummond, District Judge of the United States, for the Northern District of Illinois; and was argued for the complainant by Reverdy Johnson and E. N. Dickerson, Esqrs., and for the defendants by Edwin M. Stanton and George Harding, Esqrs.

The opinion of the Court was delivered at Washington, on the 16th of January, by Mr. Justice McLean.

OPINION OF THE COURT.

This is a bill to restrain an alleged infringement of the plaintiff's patent, by the defendants, and for an account.

By consent of parties, the case was adjourned from Chicago to Cincinnati, at which place it was argued on both sides with surpassing ability and clearness of demonstration. The art involved in the inquiry, was traced in a lucid manner, and shown by models and drawings, from its origin to its present state of perfection. And if, in the examination of the cause, the entire scope of the argument shall not be embraced, no inference should be drawn that the Court was not deeply impressed with the artistical researches and ingenuity of the counsel.

It is proper that I should say here, after the close of the argument at Cincinnati, no time was afforded for consultation with my brother judge. At my request he has lately transmitted to me his opinion on the points ruled, without any interchange of views between us, and there is an entire concurrence on every point stated.

Cyrus H. M'Cormick, a citizen of Virginia, represented to the Patent Office, that he had "invented a new and useful improvement in the machine for reaping all kinds of small grain, which improvement was not known nor used before his application, on which he obtained a patent, dated the 21st of June, 1834. As that patent has expired, and whatever of invention it contained, now belongs to the public, no further notice of it, in this place, is necessary.

The same individual, on representing to the Patent Office, that he had invented certain new and useful improvements on the above machine, obtained a patent for those improvements, dated the 31st of January, 1845.

After describing certain improvements in the cutting apparatus, the divider, and the reel-post, he makes the following claims:—

1. The curved (or angled downward for the purpose described,) bearer for supporting the blade in the manner described.

2. The reversed angle of the teeth of the blade, in manner described.

3. The arrangement and construction of the fingers (or teeth for supporting the grain) so as to form the angular spaces in front of the blade, for the purpose designed.

4. The combination of the bow *L*, and dividing iron *M*, for separating the wheat in the way described.

5. Setting the lower end of the reel-post *r*, behind the blade, curving it at *a* and leaning it forward at top, thereby favoring the cutting, and enabling him to brace it at the top by the front brace *s* as described, which he claims in combination with the post.

And afterwards, M'Cormick applied for another patent, for improvements made on his reaping machine, patented in 1845, and it was issued to him the 23d of October, 1847. This patent was inoperative, as the patentee afterwards alleged, by reason of a defective specification; and he surrendered it, and obtained a corrected patent the 24th of May, 1853.

In his specification of this patent, he says, "The reaping machines heretofore made, may be divided into two classes. The first class having a seat for a raker, who, with a hand rake equal in length to the width of the swath cut, performs the double office of gathering the grain to the

cutting apparatus and on to the platform, and then, of discharging it from the platform on the ground behind the machine.”

The defects of the first class were remedied, he says, by the second class, in which a reel was employed to gather the grain to the cutting apparatus, and deposit it on a platform, from whence it is raked off by an attendant, who deposits the grain on the ground by the side of the machine, where it can lay as long as desired; the whole width of the swath being left unencumbered for the passage of the horses on the return of the machine to cut another swath.

And he states, that the length of the reel leaves no seat for the raker, who has to walk on the ground at the side of the machine and rake the grain from the platform. And, he says, the weight of the machine is too great back of the driving wheel. For these defects, he has provided a remedy by his improvements, which places the driving wheel back of the gearing that gives motion to the sickle, which is placed in a line behind the axis of the driving wheel; and, the cog gearing which moves the crank forward of the driving wheel, so as to balance the frame of the machine with the raker on it. And, also, in combining with the reel which deposits the grain on the platform, a seat or position for the raker to sit or stand, so that he may rake off the grain thrown upon the platform by the reel, on the side of the machine farthest from the standing grain.

And, in the conclusion, he says, “What I claim as my invention, and desire to secure by Letters Patent, as improvements on the reaping machine, secured to me by Letters Patent dated the 24th of June, 1834, and the 31st of January, 1845, is placing the gearing and crank forward of the driving wheel for protection from dirt, &c., and thus carrying the driving wheel further back than heretofore, and sufficiently so to balance the rear part of the frame with the raker thereon; when this position of the parts is combined with the sickle, back of the axis of motion of the driving wheel, by means of the vibrating lever, substantially as herein described.”

And, he claims “the combination of the reel for gathering the grain to the cutting apparatus, and depositing it on the platform, with the seat or position for the raker, arranged and located as described, or the equivalent thereof, to enable the raker to rake the grain from the platform, and lay it on the ground, at the side of the machine.”

The defendants in their answers, deny the validity of the plaintiff's patent for want of novelty, and on other grounds; but in their argument, they disclaim any such purpose; and place their defence on a denial of the infringement charged.

The infringement of the plaintiff's machine by the defendants, is alleged to consist in his divider, reel-post, and its connexions, and the raker's seat.

The fourth claim in the plaintiff's patent of 1845, is, “The combination of the bow **L**, and dividing iron **M**, for separating the wheat in the way described.”

He describes the divider as an extension of the frame on the left side of the platform, three feet before the blade, for the purpose of separating the wheat to be cut from that to be left standing, and that, whether tangled

or not. This divider gradually rises from the forward point with an outward curve or bow, so as to throw off the grain to the left, and thus separate it from the grain to be cut. And this is combined with a dividing iron rod or bar, made fast by a bolt to the timber extended as a divider, which bolt also fastens the bow. From this bolt the iron rises towards the reel at an angle of thirty degrees, until it approaches near to it, when it is curved to suit the circle of the reel. This iron is adjustable to suit the lowering or elevation of the reel, by a bolt and slot in the lower end. By its gradual rise, this iron divider elevates the tangled grain, and presses it against the cutting sickles of the machine.

There can be no doubt that this combination of the bow and iron divider as claimed, is new, it not having constituted a part of any reaping machine prior to the complainant's.

In the specifications of the defendant's patents he says, "The divider F, projects on the left side of the machine in advance of the guard fingers; and divides the grain to be cut from that which is to be left standing," &c. And the machine constructed under his patent has a wooden projection somewhat in the form of a wedge, extending beyond the cutting sickles some three feet, and which from the point in front rises as it approaches the cutting apparatus, with a small curve, so as to raise the leaning grain and bring it within the reel on the inner side of the divider, and on the outer side by the projection to disentangle the heads and stalks, so as to leave them with the standing grain.

This is not dissimilar in principle, from the wooden divider of the plaintiff's machine. The curve outward may be less, and the elevation from the point which enters the grain may also be less than McCormick's, but it performs the same office, and in principle, they may be considered the same. And the question necessarily arises, whether, in this respect, this divider is not an infringement of the plaintiff's patent.

A satisfactory answer to this inquiry is not difficult.

The plaintiff claims his wooden divider in combination with the iron rod on the inner side, and which rises from its fastening at the angle of thirty degrees. The adjustability of this iron by giving it a lower or higher elevation, is also important, and would, of itself, be a sufficient ground for a patent. But in this inquiry, the adjustability of the iron divider is not important, as it may be considered stationary.

A patent which claims mechanical powers or things in combination, is not infringed by using a part of the combination. To this rule there is no exception. If, therefore, the wooden divider of the defendants' machine, be similar to that of the plaintiff's, there is no infringement; as the combination is not violated in whole but in part. But there is another, and equally conclusive answer to the objection.

The plaintiff's wooden divider was not new, and, therefore, could be claimed only in combination.

The English patent of Dobbs, in 1814, had dividers of wood or metal. The outer diverging rod of Dobbs' divider, rises as it extends back, and, at the same time, diverging laterally from the point of the divider, acts the same as the McCormick divider of 1845, to raise stalks of grain inclining inwards, and to turn them off from other parts of the machine.

The English patent of Charles Phillips, in 1841, had a dividing apparatus, consisting of a pointed wedge-formed instrument, which extended some distance in advance of the cutting apparatus and reel; its diverging inner side, like the corresponding side of M'Cormick's divider, of 1845, bears inward upright grain within the range of the reel and cutting knives; while at the same time its outer diverging edge, like the outer edge of M'Cormick's divider, bears off standing grain without the range of the reel. And there is an inclined bar, which being attached by its front to the lower piece, extends backwards and upwards, until it meets the frame of the machine, at a point above and behind the cutting apparatus. Ambler's machine had also a divider not dissimilar to the defendant's.

Bell's machine, made in 1828, had dividers on it to press the grain away from the machine on the outer side, and on the inner side to press it to the cutters. Hussey's machine, too, had a point which projected into the grain and dividing it, before the cutting knives, the inside to be cut, the outside to remain with the standing grain.

In Schnebly's machine, the grain to be cut was separated from that which was left standing, by a divider projecting on the side of the machine.

In the plaintiff's patent of 1834, he says, "on the left end of the platform is a wheel of about fifteen inches diameter set obliquely, bending under the platform to avoid breaking down the stalks, on an angle that may be raised or lowered by two movable bolts, as the cutting may require, corresponding with the opposite side. The projection of the frame at this end is made sufficiently to bear off the grain from the wheel." And he claims, "the method of dividing and keeping separate the grain to be cut from that to be left standing."

This patent having expired, whatever of invention it contained, now belongs to the public, and may be used by any one.

The inner line of the projecting divider of the defendants' machine, it is contended, has a gradual rise from the point, which answers the purpose of the iron divider of M'Cormick's, to crowd the grain on the reel and cutters; but, in this respect, the wooden divider of the defendant is not materially different from those above referred to and others in use, before the plaintiff's patent of 1845.

In regard to the divider, in the defendants' machine, it is clear, that it cannot be considered as an infringement of the plaintiff's patent.

The reel-post, as claimed, with its connexions, by the plaintiff, seems not to have been infringed by the defendants.

In defendants' machine, the end of the reel, next the standing grain, is supported by an adjustable arm, which is nearly level, slightly inclined upwards, and supported by a standard towards the rear of the machine. In M'Cormick's patent of 1845, the reel-post is set back of the cutter some nine inches at its foot, rising upwards, and projecting forwards, and supported at its top by a brace running to, and connected with, a standard on the tongue of the machine. The reel-post of the defendant is substantially like the one in Bell's reaping machine, and also the patent granted to James Ten Eyck, in 1825. The reel-support or bearer of the latter has not the features of vertical and horizontal adjustability con-

tained in the reel-bearer of the defendants ; but it is attached to the machine behind the platform on which the cut grain is received, and it extends forward to hold the reel and to leave the space beneath it unobstructed.

In his patent of 1834, M'Cormick placed his reel-post before the cutting apparatus, standing perpendicularly and being braced as described. But, in the patent of 1845, that post was set nine inches behind the sickles, leaning forward so as to bring the part of it which supported the reel to its former perpendicular, the post still extending forward so as to admit of being braced directly to the tongue of the machine, to which the horses are harnessed.

This was rendered necessary, as the first post being in advance of the cutters, encountered the fallen grain which adhered to it, and clogged the machine.

The reel-posts, so-called, in both these machines were alike only, as bearers of the end of the reel next to the standing grain ; but their structures in every other respect, are different. M'Cormick's reel-post served as a brace to the machine, its foot being mortised into the left sill of the machine, nine inches behind the cutting sickles, its top leaning forward was braced to the tongue of the machine. The defendant's reel-post, like that of Bell's, was connected with the hindmost part of the machine, and was sustained by braces as the reel-bearer. In giving strength to the machine, it was unlike the plaintiff's, and if this were not so, the defendant's is sustained by similar reel-posts in other machines prior to M'Cormick's. But, in addition to these considerations, the plaintiff claims his reel-post in combination with the tongue of the machine as described. There is no pretence that this combination has been infringed.

From the structure of M'Cormick's reaper, it was impossible to find a seat for the raker, without an adjustment of the machine, which should balance it with the weight of the raker behind the driving wheel. For this purpose the gearing and crank were placed further forward, the finger-piece was extended, and the reel shortened so as to make room for the raker, and enable him to discharge the grain at the side of the machine, opposite to the standing grain. This improvement was claimed, as a combination of the reel with the seat of the raker.

In his specifications to the patent of 1853, M'Cormick describes two classes of machines. The first class having a seat for a raker, who, with a hand rake having a head equal in length to the width of the swath cut, performs the double purpose of gathering the grain to the cutting apparatus, and on to the platform, and then of discharging from the platform behind the machine. This was defective principally, he says, because the grain was discharged behind in the wake of the machine, rendering it necessary to remove the grain before the return of the machine, and he alleges these defects are obviated by his improvement.

In the defendant's specifications to his patent of the 6th of March, 1855, he says, after referring to M'Cormick's, Schnebly's, Woodward's, and Hite's machines, in regard to the seats of the rakers, "The improvement of mine consists, in combining with the reel which gathers the grain to the cutting apparatus, and deposits it on the platform, a seat or position arranged between the inner end of the platform and the end of

the machine next the standing grain, for an attendant to sit or stand on, and which gives due support to him while operating a fork to push the cut grain towards the outer end of the platform, where the grain is first compressed against the wing or guard provided for the purpose, and then, by a lateral movement of the fork discharged properly on the ground behind the platform in gavels, ready to be bound into sheaves."

And in summing up, the defendant says, "What I claim is the combination of the reel for gathering the grain to the cutting apparatus, and depositing it on the platform, with the stand or position of the forker, arranged and located as described, or the equivalent thereof, to enable the forker to fork the grain from the platform and deliver and lay it on the ground at the rear of the machine as described.

With a few verbal alterations, this claim is the same as made by the plaintiff, with exception of the seat of the raker, and the place of deposit for the grain.

It must be admitted that the combination of the raker's seat with the reel, as claimed by the plaintiff, was new; and a very important question arises how far this claim extends; is it limited to the mode of organization specified, or may it be considered as covering the entire platform of the machine, and all combinations of the seat and reel?

The reel was not new; nor was a seat on the platform, or connected with the platform for the raker, new; but the position for the raker *as described* by M'Cormick, was new. Mr. Justice Nelson, in the case of *M'Cormick vs. Seymour and Morgan*, in his charge to the jury, said, "the seat was the object and result he was seeking to attain by the improvement which he supposed he had brought out. What he invented was the arrangement and combination of machinery which he has described, by which he obtained his seat. That, and not the seat itself, constituted the essence and merit, if any, of the invention."

The reel was advanced in front of the cutters and shortened, and the driving wheel was put back; and the gearing forward, so as to balance the machine with the weight of the raker on the extended finger-piece. In this peculiar organization, the improvement of M'Cormick consisted. It was adapted to no other part of the machine. To place the raker on any other part of the platform or machine of M'Cormick than on the extended finger-board, would derange its balance, which was so well adjusted by the improvement described. No such change can be made without experiment and invention, consequently, the improvement of the plaintiff, in this respect, is limited to his specification.

In 1844, Hite made a new and useful improvement on M'Cormick's reaping machine, patented in 1834, by attaching thereto a seat, mounted on wheels for a raker to occupy, when raking the grain from the platform, on which it is deposited by the reel. And a patent was issued in 1855, for this improvement, although, from the evidence, the presumption was, that the improvement had gone into public use more than ten years.

William Schnebly, at Hagerstown, from 1825 to 1837, constructed reaping machines. At first a revolving apron was used, but this was discontinued, and after the grain had been thrown on the platform by the reel and the proper motion of the machine, he says, "He sat upon the machine in rear of the platform, sometimes upon the guard board and

sometimes astride a cap or cross-beam suitable for that purpose, and raked off the grain with a three or four-pronged fork from the platform and deposited it on the ground at the side of the machine."

In the specifications of Woodward's machine, patented in 1845, he says, "The raker stands upon the platform, *L*, and, as the grain is cut and falls upon the platform, he, with a fork or rake, conveys it to the hinged box, and when a quantity is accumulated therein sufficient, the rear end of the box falls and deposits the wheat on the ground in the form of a gavel." This box was often dispensed with. The raker rode on the machine.

In 1844, Nicholson represented that he had made an improvement on a machine for cutting grain, &c., and he says, "The machine is provided with a pair of shafts, *L*, for the animal to draw by, and a place, *A*, for the driver to sit on, and a suitable stand for a raker's seat." And as a part of his improvement, he claims a mode of depositing the grain in a line out of the track of the horse, as described. In 1855, a patent was issued for this improvement to the administrator of Nicholson.

In Abraham Randall's patent, dated in 1833, the grain was raked off the machine by a raker who had a seat on the platform. This part of the machine succeeded well. When a sufficient amount of grain was collected on the platform to make a sheaf, it was raked off the side. The machine was in use several years.

The platform of the defendant's machine is different from that of the plaintiff's. The latter is constructed, so that the side next to the reel and the cutting knives, is parallel with them, whilst Manny's platform is so constructed, as to extend back from the cutters in a diagonal form, which brings its hindmost part, through which the grain is discharged, to the right of the swath cut. This leaves the way open for the machine in cutting the next swath. The raker in this machine, occupies a place behind the running ground wheel at the rear of the divider with his face quartering to the horses.

Whether we look at the structure of the platforms or the position of the rakers, no two things could be more unlike than the two machines of the plaintiff and defendants. Do they differ in principle as well as in form? To provide for M'Cormick's raker, the structure of the machine had to be altered materially by changing the heavy machinery, so as to balance it with the weight of the raker on the extended finger-board. The reel had also to be shortened.

On Manny's machine the raker occupies a place diagonal to that of M'Cormick's, and at the farthest part of the platform next to the standing grain. He stands not upon the extended finger-board, but on the platform, requiring no shortening of the reel nor balancing of the machine.

From the patents above referred to, it appears that before the last improvement of M'Cormick, rakers had been placed upon the machines, intended to perform the same office as M'Cormick's raker. It is no answer to this fact to show that some of these plans were abandoned or superseded by the progress of improvement. They were embodied in patents and were not only publicly constructed and used, but the models of the machines were deposited in the Patent Office, and the patents, with their specifications and drawings, were matters of public record.

Now, if these various plans of seating a raker on the machine, as called for in other patents prior to that of M'Cormick's, did not affect the validity of his subsequent patent, it could hardly be contended that his patent excludes all subsequent improvements for a raker's seat. In the case of *M'Cormick vs. Seymour and Morgan*, Mr. Justice Nelson argues very properly in saying, "It is insisted on the part of the learned counsel for defendants, that there is nothing new in this, because there is in the machine of Hussey a seat, or, what is equivalent, a position for the raker, in which he may stand and rake off the grain. The seat, that is, the position on the platform, is, in one sense, undoubtedly common to both. But Hussey's machine has no reel to interfere with the raking, and the grain, instead of being raked from the platform, is pushed from the back part of it. The question is, whether the arrangement of the seat, the combination by which the patentee obtains and can use the seat or position, is similar to, or substantially like, the contrivance in Hussey's machine; that is the point. The mere fact that a seat was used in previous reapers, does not embrace the idea contained in this patent. That view could only be material under the assumed construction given by the learned counsel for the defendants to the patent that it is for a seat. If that were the thing invented and claimed by the patentee, then the seat of Hussey would be an answer to the claim."

"There is, also, another point," says the learned judge, "to which it is proper to call your attention in this connexion, and which has been the subject of discussion by the counsel, and that is, that Hussey, in the construction of his machine, in Ohio, at a very early day, used a reel in connexion with his cutter and a raker. It is insisted that this use of the reel, in connexion with a raker in Hussey's machine before the discovery of the plaintiff, destroys his claim to originality. In answer to this it is claimed, on the part of the counsel for the plaintiff, that the contrivance of Hussey, into which the reel was introduced, was substantially different from the plaintiff's contrivance. It appears that Hussey's reel, like the reel of the plaintiff, when his first seat was put on in 1845, interfered with the raker, so as to prevent his raking the grain the whole length of the platform. Hence, Hussey had an endless apron by which the grain, when cut, was deposited at the feet of the raker, so that he could shove it off with his rake."

I have cited largely from the learned judge, not only because the opinion was greatly relied on by the plaintiff's counsel in the argument of this case, but for the reason that the opinion is sound. The reel, it seems, interfered with Hussey's plan, which was obviated by an endless apron. M'Cormick dispensed with the apron by putting back the driving wheel, and placing forward the gearing, &c., so as to balance the machine, which, with the shortening of the reel, completed his improvement.

Now, if a raker be seated on a different part of the machine, and where he can rake without balancing the machine, and without interruption from the reel, it is a contrivance and an invention substantially different from M'Cormick's. To seat the raker on Manny's machine, does not require the same elements of combination that were essential in M'Cormick's invention. His invention, in procuring a seat for the raker, being new and

useful, was unaffected by those which preceded it. But Manny's contrivance required no such modification and combination of the machinery for a raker's seat as M'Cormick's; it is, consequently, substantially different from his. The seat was not the thing invented, but the change of the machinery to make a place for it. And when the seat may be placed on the platform or on any part of the machine which does not require substantially the same invention and improvement as M'Cormick's, there can be no infringement of his right.

In M'Cormick's claim for the improvements which gave him a seat for the raker, "arranged and located as described," he adds, "or the equivalent thereof."

The words of this claim, "or the equivalent thereof," cannot maintain the claim to any other invention, equivalent or equal to the one described. This would be to include all improvements or modifications of the machine, which would make it equal to M'Cormick's. This part of the claim cannot be construed to extend to any improvements which are not substantially the same as those described, and which do not involve the same principle. It embraces all alterations which are merely colorable. Such alterations in a machine afford no ground for a patent.

As stated by Mr. Justice Nelson, the improvement of M'Cormick, consisted, not in the seat for the raker, but in the modification and new combination of parts of his machine, so as to secure a place for a seat. Had a construction of the seat, merely, been the invention, that learned judge admitted, the prior seat for the raker on Hussey's machine, would have nullified the claim.

Having arrived at the result, that there is no infringement of the plaintiff's patent by the defendants, as charged in the bill, it is announced, with the greater satisfaction, as it in no respect impairs the right of the plaintiff. He is left in the full possession of his invention, which has so justly secured to him, at home and in foreign countries, a renown, honorable to him and to his country, which can never fade from the memory so long as the harvest home shall be gathered.

The bill is dismissed at the costs of the complainant.

MECHANICS, PHYSICS, AND CHEMISTRY.

For the Journal of the Franklin Institute.

Mechanical Engineering as applied to Farm Implements. By H. HOWSON,
Civ. Eng.

(Continued from page 141.)

The irregular forms presented by potatoes when cut and prepared for planting, render the adaptation of labor saving machinery to that tedious operation, a matter of no little difficulty.

Nearly all other seeds used by farmers are comparatively uniform in size and figure, and consequently, readily discharged through orifices at suitable intervals by arrangement of stops and valves; hence the variety of planting machines to be found in every section of the country, for

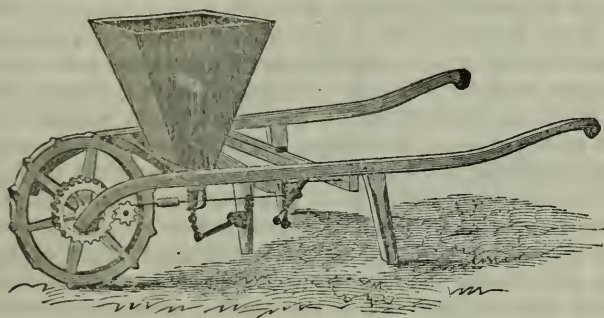
depositing every other description of seed in the ground, excepting potatoes.

*Morgan's Potato Planter.**

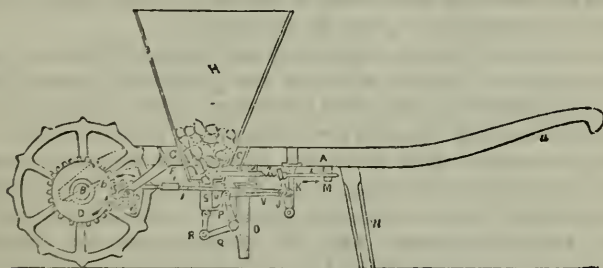
Mr. Charles Morgan, of this city, in directing his attention to, and experimenting upon, machinery for planting this important farm produce, discovered that by sticking a three pronged fork into a bucket full of potatoes prepared for planting, seldom if ever more than one cutting at a time adhered to it. This discovery paved the way to the completion of the implement's here illustrated; an implement at once simple and ingenious, and well-deserving of the patent granted to the inventor on the 12th of February last.

In the annexed perspective and sectional view

AA, are the two side frames of the machine, furnished at one end with handles *a*, similar to those of an ordinary wheel-barrow, and at the other end, with boxes for the journals of the axle B, on which is secured a



wheel having on its periphery a series of pointed projections for maintaining a hold on the ground. On the axle B, is secured a toothed wheel D, gearing into the pinion E, which runs loose on a pin secured to a



hanger which is suspended from the cross-piece c. Two of these cross-pieces connect the opposite frames A together, and are beveled for receiving the hopper H. To the wheel E, and at a suitable distance from its

* Manufactured by Messrs. Paschall Morris & Co., the extensive builders of farm implements in this City, and in Reading.

centre, is secured a pin, to which is connected the end of the rod *l*, the latter having a nut with left and right handed thread for lengthening and shortening the said rod. The opposite end of this rod is connected to a pin in a lever *j*, which vibrates on a stud secured to the bottom of the hanger *k*, on a cross bar of the frame.

The top of the lever *j*, has an oblong eye, through which passes the horizontal rod *l*, the latter being guided at one end by passing through a cross-bar *m*, secured to the frame *A*; the other end is furnished with a fork having three prongs, and these prongs pass through and are guided by another cross-bar *n*, also attached to the frame *A*. The eye of the lever *j* is confined between a collar on the horizontal rod *l*, and a spiral spring which surrounds the said rod and bears against the collar formed by the termination of the forks.

To the cross-bar *n* is secured a tube or runner *o*, in front of which is a lug for receiving a pin, to which is secured the lever *p*, on the opposite side of the lug and to the same pin is attached another lever *q*, the end of which is connected by means of a link *r*, to a plunger *s*, which fits in a tube at the bottom of the hopper *h*. The latter has an opening at the bottom in order to allow the prongs of the fork to have free access to the interior, and the plunger *s* is furnished with a curved projection *u*, which at certain intervals in the movement of the machine, is raised across the said opening at the bottom of the hopper. To the end of the lever *p*, is jointed the rod *v*, the end of which is furnished with a slotted eye adapted to a pin on the lever *j*. The frame *A*, is furnished with legs *w*, after the manner of an ordinary wheel-barrow. The hopper *h* being filled with potatoes, cut and prepared for planting, the operator takes the handles *a*, and raising the legs, wheels the machine over the ground, causing the wheel *c*, and with it the toothed wheel *d*, to revolve, this communicates motion to the pinion *e*, and through the rod *l*, a vibrating motion to the lever *j*, and a horizontal reciprocating motion to the forked rod, causing the prongs at the end of the latter to be moved in and out of the hopper *h*. Simultaneously with this movement, the plunger *s* is caused to be raised up and down in the tube of the hopper by the rod *v*, connected to the lever *j*, and levers *p* and *q*.

As the machine is shown in the sectional view, the fork is about withdrawing a piece of potato, which it has previously pierced, from the hopper. The continued backward movement of the horizontal rod draws the prongs of the fork through the cross-bar *n*, until the piece of potato coming in contact with the latter, is released from the point of the fork and drops down the tube *o*, into the bottom of the furrow. The slot at the end of the rod *v*, is so regulated that the latter as well as the plunger *s*, remains stationary until the potato at the end of the fork is nearly clear of the opening of the hopper, when the plunger *s*, is suddenly raised, stirring up the potatoes in the hopper; at the same time the curved projection also rises covering the opening of the hopper and preventing the potatoes dropping therefrom. On the return movement of the fork, however, the projection *u* is withdrawn from the opening, so as to allow room for the fork to penetrate the hopper. It will be seen that the distance apart at which the pieces of potato are dropped into the furrow, will be regulated by the diameter of the pinion *e*, compared

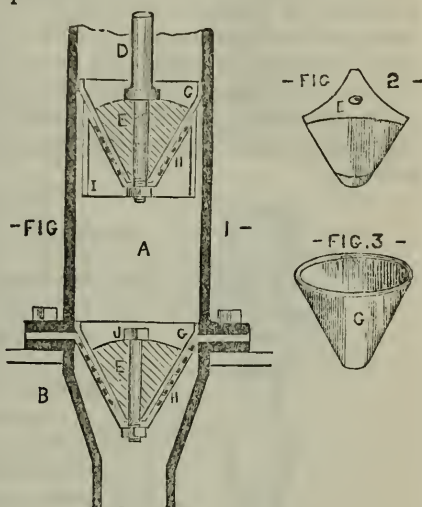
with that of the wheel D, so that by removing the pinion E, and replacing it by a larger or smaller one, the pieces of potatoes may be dropped into the furrow at any distance apart required.

Weis and Ran's Farm Pump.

This invention, for which a patent was granted to Joseph Weis, of Bordentown, N. J., in December, 1855, is not applicable to farm uses alone; as a simple pump, however, and one easily repaired, it is particularly well adapted to general agricultural purposes, and as such is well worthy of a place in these papers.

In the annexed engraving, fig. 1, is a sectional elevation of part of an ordinary pump barrel, with Weis's improved buckets and valves. Figs. 2 and 3, are detached views of portions of the latter.

A is the barrel; B the cistern of water; I, is a light cylindrical piece of metal, somewhat less in diameter than the box of the barrel: to this cylinder is secured the perforated metal cone H, inside which is placed a cone-shaped piece of leather, gutta percha, india rubber, felt, or other similar substance represented in fig. 3. This elastic cone G, is so arranged that its upper end shall fit the bore of the barrel A, and inside the cone is placed a three-winged block E (fig. 2). Through the latter is bolted the end of the pump rod D, in such a manner as to secure the cylinder I, perforated metal cone H, elastic cone G, and block E, together. The above forms the bucket of the pump. The valve is constructed in nearly a similar manner; the cylinder I, only being dispensed with, and the perforated cone H, secured between the flanch of the barrel and that of the suction pipe, and the block E, and elastic cone C, attached to the perforated cone by a simple bolt J.



On the descent of the bucket, the water in the barrel passes through the perforations in the cone H, and through the annular space between the barrel and cylinder I, causing the elastic cone G, to collapse into the spaces between the wings of the block E, and allowing a free passage for the water to the upper portion of the barrel. Immediately on the bucket being raised, however, the elastic cone instantly recovers itself, and pressing against the sides of the barrel prevents the return of the water, and at the same time becomes a sucker of the most efficient kind. The action of the elastic cone in the valve is too similar to that in the bucket to need further description. The claim is, "the wedge-shaped block E, with any convenient number of wings, in combination with the perforated hollow cone H, and its similarly shaped piece of gum elastic

or other similar substance G, arranged and constructed substantially as herein specified, the same to be applied as buckets and valves for pumps."

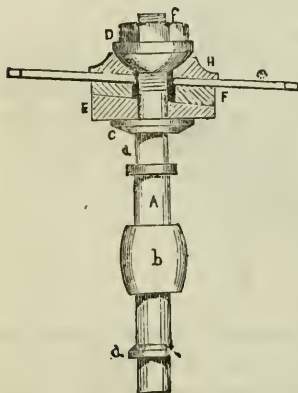
(To be Continued.)

For the Journal of the Franklin Institute.

Harrison and Highfield's Adjustable Circular Saw for Cutting Grooves.

By H. HOWSON.

Although the present mode of cutting grooves in wood for building purposes, by means of revolving cutters of the same width as the desired groove, is most rapid as well as generally efficient in practice, it is nevertheless objectionable in many respects. The tendency of such cutters to become quickly dull, their liability to break, as well as the expense necessarily involved in preparing and fitting them up with due exactitude, are all evils which detract from the merits they undoubtedly possess.



The arrangement of circular saw and spindle adapted for cutting grooves, as represented in the annexed engraving, exhibits no little ingenuity on the part of the inventors and patentees, Messrs. Harrison and Highfield, of this city, and possesses as well the important qualities of simplicity, cheapness, and efficiency.

A is the spindle, of which *a a* are the journals, and *b* the pulley for receiving the driving strap. *c*, is a collar forged to, and turned perfectly true with the spindle. To a short distance beyond the collar, the spindle is continued plain, and the remaining portion *f*, is screwed for receiving the nut *d*. Against the collar *c*, rests the beveled washer *E*, fitting easily on the plain portion of the spindle beyond the collar. *F*, is a second and similar beveled washer, having an orifice somewhat larger than the spindle; against the face of this second washer rests the circular saw *G*, outside which is a third washer *H*, having a concave recess for receiving the convex end of the nut *D*.

When the thinnest portion of the edge of the beveled washer *E*, is placed so as to coincide with the thickest portion of the edge of the washer *F*, the face of the saw will be at right angles to the spindle *A*; but when the relative positions of the two washers are changed, the saw becomes more or less oblique, with the spindle, the amount of obliquity being regulated by the turning of the washers; and consequently, the width of the groove cut into the wood submitted to its action may be regulated at pleasure.

On the edge of one of the washers is cut a dial, and on the edge of the other a notch acting as the pointer; the several marks on the dial indicating that when moved so as to coincide with the pointer, the saw will be at such an angle with the spindle, as to cut a groove of a stated width.

For the Journal of the Franklin Institute.

Particulars of the U. S. Steam Frigate Niagara.

Hull designed by George Steers, Esq., and built at U. S. Navy Yard, Brooklyn. Machinery by Pease & Murphy, New York.

HULL.—

Extreme length from taffrail to figure head,	345 feet.
Length on deck, from fore part of stem to after part of stern post above the spar deck,	337 "
Breadth of beam at midship section, (molded)	53 " 8 inches.
" " " " (extreme)	55 "
Depth of hold,	23 "
" " to spar deck,	31 " 3 "
Length of engine and boiler space,	100 "
Draft of water at load line,	23 "
" " below pressure and revolutions,	23 "
Tonnage,	4750.
Area of immersed midship section at above draft,	911 sq. feet.
Contents of bunkers in tons of coal,	1000.
Ratio of length to breadth on load line,	5979.
Height of port sill above load line,	14 feet 10 "
Distance of dead flat abaft middle of length on load line,	7 " 3 "
Centre of buoyancy " "	8 " 7 $\frac{3}{4}$ "
" of gravity of displacement below load line,	8 "
Molded displacement at 23 feet draft,	5110 tons.
Total, " "	5440 "
Area of load water line,	12,755 sq. feet.
Meta centre above load line,	5 feet 6 inches.
Moment of stability, ($S\frac{2}{3}y^3dx$),	2415560.
Weight of hull,	2750 tons.
" " iron bolts in hull,	400,000 lbs.
" " galvanized iron and spikes,	130,000 "
" " copper bolts,	25,000 "
" " composition bolts,	16,000 "
" " Diagonal iron braces,	169,000 "
Armament, 12 eleven-inch pivot-guns,	
probable weight of each,	2,700 "

ENGINES.—Horizontal—cross-head—double-piston.

Diameter of cylinders,	three of	72 inches.
Length of stroke,		3 feet.
Pressure of steam in pounds,	20.	
Cut-off at	$\frac{3}{8}$.	
Revolutions per minute,	40.	
Weight of engines, extras, tools, &c., in tons,	315.	

BOILERS.—Four—vertical return tubular.

Length of boilers,		11 feet. 6 inches.
Breadth " "		21 "
Height " exclusive of steam chimney,		15 " 6 "
" " inclusive " "		18 "
Weight of " without water, in tons,	285.	
Number of furnaces,	6 in each.	
Breadth of " "		2 " 10 $\frac{1}{2}$ "
Length of grate bars,		7 " 4 "
Number of tubes in each boiler,	2040.	
Internal diameter of tubes,		1 $\frac{3}{4}$ "
Length of tubes,		3 " 3 "
Heating surface, (fire and flues,)		17,500 sq. feet.
Diameter of smoke pipes, (two,)		7 feet.
Height,		60 "
Description of coal,	Bituminous.	
Combustion,	Natural draft.	

PROPELLER.

Diameter of screw,	.	.	.	18 feet 3 inches.
Length of blades,	.	.	.	4 " 8 "
Number "	.	.	two.	
Pitch of screw,	.	.	.	29 " 6 "

Remarks.—Frame of live oak. Floors, *molded* $20\frac{1}{2}$ ins., and 8 ins. at heads; *sided* 15 ins. Distance of frames apart *at centres*, 40 ins., and filled in solid to a line six feet above base line with live oak.

Weights.	Spar, rigging and sails,	225 tons.	
"	Armament,	257 "	
"	Stores,	326 "	C. H. H.

For the Journal of the Franklin Institute.

Particulars of the Steamer Persia.

Hull and Machinery built by Robert Napier & Sons, Glasgow. Intended service, New York to Liverpool.

HULL.—

Length on deck,	.	.	.	376 feet.
" load line,	.	.	.	360 "
Breadth of beam at midship section,	.	.	.	45 " 3 inches.
Depth of hold,	.	.	.	22 "
" " to spar deck,	.	.	.	30 "
Length of engine and boiler space,	.	.	.	115 by 45 "
Draft of water at load line,	.	.	.	23 " 6 "
" " below pressure and revolutions,	.	.	.	18 "
Tonnage, English, engine-room,	1221,	} 3500.		
" " deck cabin,	200,			
" " hold,	2079,			
Contents of bunkers in tons of coal,	1400.			
Masts and rig—barque.				
Weight of vessel,	.	.	5400 tons.	
" hull (launching draft),	.	.	2200 "	

ENGINES.—Side Lever.

Diameter of cylinders,	.	.	.	100 inches.
Length of stroke,	.	.	.	10 feet.
Maximum pressure of steam in pounds,	21.			
" revolutions per minute,	18.			

BOILERS.—Eight—Horizontal Tubular.

Number of furnaces,	.	40.	
Description of coal,	.	Bituminous.	
Combustion,	.	Natural draft.	
Consumption of coal per hour,	.	4½ tons.	

PADDLE WHEELS.

Diameter,	.	.	.	40 feet.
Length of blades,	.	.	.	10 " 8 inches.
Depth,	.	.	.	36 "
Number,	.	.	38.	

Remarks.—Frame of wrought iron plates $1\frac{5}{8}$ to $1\frac{1}{8}$ ths thick. Floors (Σ) molded 10. Sided $9\frac{1}{8}$ and $6\frac{1}{2}$. Distance of frames apart *at centres*, 18 to 20 inches. Has six water-tight bulkheads. The frames do not rest upon the keel, consequently, the only connexion between the keel and frames, is that of the garboard strakes.

Has accommodations for 200 passengers; and carries 1200 tons freight.

The above dimensions differ essentially from any yet published. They are believed to be correct.

C. H. H.

For the Journal of the Franklin Institute.

Particulars of the Steamboat Morning Star.

The engineers of Pittsburgh, Pa., are fitting eight boats with machinery of the usual kind and proportions common to the Western rivers. Seven of them are intended to run during the times of extreme low water, and have stern wheels with the engines connected at right angles.

Nearly all have a small steam engine, termed *the nigger*, and boiler, to be used for hoisting cargo, and for the peculiar operation known as *sparring*; in which the boat is lifted bodily over the shoals by means of tackle attached to each side of the hull near the bow, and to the upper ends of two spars whose lower ends are planted on the bar upon which the boat is grounded; by their means the bow of the boat is raised clear of the ground, when the paddle-wheel is put in motion, urging the boat forward until again a-ground, when the process is repeated until the bar is passed over. Sparring used to be performed by manual power, but the slowness of the mode, with its greater expense, owing to the number of men required, and the great danger to life and limb, has caused it to be superseded by *the nigger*.

The details of one boat only, could be obtained from reliable sources, and they are herewith presented to the readers of the *Journal*.

Hull built by W. B. Walker. Machinery by A. Irwin & Co. Owners, Messrs. Briery & Weaver. Intended service, Missouri River.

HULL.—

Length for tonnage, ...	210 feet.	
“ on deck, ...	227 “	
Breadth of beam at midship section, ...	34 “	
Depth of hold, ...	6 “	6 inches.
Shaft, forward of stern post, at deep load line, ...	75 “	
Draft of water at deep load line, ...	6 “	

ENGINES.—Slightly inclined.

Diameter of cylinders, ...		25 inches.
Length of stroke, ...	7 feet	
Maximum pressure of steam in pounds, determined by law for boilers of the below diameter, 14-37.		
Cut-off at	$\frac{1}{2}$.	
Maximum revolutions per minute, (estimated,)	20.	
Weight of engines in pounds, ...	160,000.	

BOILERS.—Four—cylindrical.

Length of boilers, ...	28 feet.	
Diameter “	3 “	4 inches.
Height “ above deck exclusive of steam drum, ...	7 “	3 “
Weight of “ in pounds, ...	33,600.	
Number of furnaces, ...	1.	
Breadth of “	15 “	5 “
Length of grate bars, ...	4 “	
Number of flues or tubes, ...	8.	
Internal diameter of flues or tubes, ...		15 “
Length of flues or tubes, ...	28 “	
Heating surface, ...	1792 sq. feet.	
Diameter of smoke pipes, ...	5 feet.	
Height “	60 “	
Description of coal, ...	Bituminous.	
Draft, ...	Natural.	
Consumption of coal per hour, estimated, 2500 pounds.		

PADDLE WHEELS.—

Diameter,	.	.	.	28 feet.
Length of blades,	.	.	.	10 "
Depth,	.	.	.	28 inches.
Number,	.	.	18.	
Dip of wheels at load line,	.	.	.	3 "
Average revols. per min., estimated,	.	.	20.	

Remarks.—Hull of light build for shoal water navigation.

Accommodations for one hundred second class passengers on the main deck. Upon the hurricane deck is the dining saloon, which is elegantly ornamented with gilded carved work, and lighted with windows of stained glass. On each side are twenty-five state rooms, containing berths for two hundred passengers. The *doctor engine* works four pumps; two for supplying the boilers, one for the bilge water, and the other for extinguishing fire. Two other pumps, worked by hand, may be used for bilge water, washing decks, or for putting out fires. W. J.

Translated for the Journal of the Franklin Institute.

Notes from the Academy of Sciences at Paris.

Poisoning by Paint.—M. Marchal de Calvi has experimentally demonstrated, that the cases of poisoning by remaining in newly painted rooms, are not due, as has been hitherto supposed, to the white lead, but to the vapors of oil of turpentine. According to him, the effects will be the same, whether the paint employed be lead, zinc, or other, so long as the oil of turpentine or any of its analogues is employed as the medium. He compares this kind of poisoning to that which is due to the emanations from flowers, and proposes to treat it by the energetic employment of stimulants.

Discharge of Acid Vapors from the Chimneys of Manufactories.—MM. Ch. and Al. Tissier propose to prevent the discharge of acid vapors from the chimneys of manufactories by passing the vapors of the furnace through a lime-kiln. The heat of the kiln helps the draft of the furnace and promotes the absorption of the acid by the lime. The idea is certainly a fruitful one, and may be, in many cases, so applied as to add a new valuable product to the manufactory.

Newton's Rings.—M. Carrere reproduces Newton's rings by letting fall upon a surface of water, a drop of the solution of bitumen of Judea, in a mixture of benzine and naphtha. The colors at first change rapidly, but finally become fixed, by the solidification of the film through oxidation. The film may be then fixed on paper, by laying the sheet below it, in the water, and gradually drawing off the water, as is done in pressing seaweeds. To render the film more coherent, and thus the colors more regular, a little caoutchouc is mixed with the bitumen. The same phenomenon may be very brilliantly shown by exposing to the air, warm and recently filtered ink, in which sugar is the cohesive ingredient. In this case, as the thickness of the film, which forms on the surface of the ink, increases very slowly, the order of the colors is plainly and finely shown but it is difficult to fix it on paper, and it can only be done by allowing the

film to acquire great thickness, depositing it on unsized paper, and soaking the paper before drying, with gelatine.

Preparation of Aluminum.—M. Deville presented a new memoir on the preparation of aluminum; the only important novelty in which, appears to be the fact that the alkaline fluorides (such as fluor spar) appear to be the best fluxes for the metal. They are now making aluminum from kryolite, a double fluoride of aluminum and sodium, which occurs somewhat abundantly in Greenland.

Water contained in Snow.—Before the Academy of Sciences of St. Petersburg, M. Jeleznov related an experiment which he had made at Naronovo on the 3d and 4th of April, 1855, upon the height of the snow upon the ground and the quantity of water which it contained. The following are the results in inches and lines:—

	Depth of Snow.	Depth of Water.	Ratio. Depth of Water. Depth of Snow.
1	30 inches.	96 lines.	0.330
2	25.4 "	78.8 "	0.308
3	22.8 "	60.6 "	0.266
4	18.4 "	45.5 "	0.247
5	11.1 "	21.9 "	0.197
6	5.12 "	8.9 "	0.174
Means.	18.83 inches.	51.87 lines.	0.252

It will be seen by this table that the density of the snow doubled for the heights of snow varying from 1 to 6, and that as a mean, the density of the snow in this locality was one-quarter of the density of water.

An anomaly of some importance to be remarked, because it shows what erroneous results our rain-gauges may give, was established by these experiments. Thus it seems by the table, that the quantity of water given by the melted snow was 57.84 lines. Now, the quantity of water, according to the rain-gauges of the same locality, from 9th of December, 1854, to 4th of April, 1855, was only 34.71 lines, that is, less by 17.16 lines than that contained in the snow which covered the ground on 4th of April. How much greater would the difference be if we should take into account the quantity which evaporated and that which must have been absorbed by the ground? It was already known that the gauges gave only uncertain results, depending upon various causes, such as the force and direction of the wind, the hygrometric state of the air, the temperature, &c., but it will not be without use to place on record facts which give an idea of the great want of accuracy in such results.

Helioplastic Engraving.—M. Becquerel described at the meeting of 14th of January, the processes of engraving photographs invented by M. Poitevin, and called by him *Helioplastic Engraving*. It rests upon the property which gelatine has, when dried, impregnated with a chromate or bi-chromate and submitted to the action of light, of losing its property of swelling in water, whilst gelatine similarly prepared and not impressed, swells nearly six times its volume. A more or less thick layer of solution

of gelatine is laid on a plane surface, such as glass, suffered to dry, and then plunged into a solution of a bi-chromate, whose base has no direct action on the gelatine; it is again dried, and then influenced either through a photographic negative or a positive picture, or in the focus of a camera. After the impression, which must vary with the intensity of the light, the layer is plunged into water; then all the parts which have not received the influence of the light, swell and form reliefs, while those which have been affected absorb no water and remain as depressions. This surface is then transposed upon metal plates either by moulding in plaster or by the electrotpe process.

The second process which M. Portevin employs for the purpose of applying, photographically, fatty matter upon paper, stone, or metallic surfaces by means of the action of light upon mixtures of chromates with gummy or mucilaginous matters, consists in applying one or more layers of this mixture upon the surfaces, and in impressing them, after drying, through the negatives of the pictures to be reproduced. Applying then, a fat ink by a tampon or roller, it will adhere only on the parts which have been acted on by the light. He has also applied colors either in powder or otherwise upon various surfaces upon the same principles.

Several specimens were shown to the Academy.

On Working Steam Expansively in Marine Engines. By Mr. E. ALLEN.*

(Continued from page 138.)

Table V. gives the total space occupied by the machinery and coals relatively to the entire hulls, and includes the averages of six vessels with side-lever engines, and six vessels with direct-acting engines, all belonging to the Peninsular and Oriental Steam Navigation Company; also the average of 1200 English merchant vessels.

From this Table it appears that from 34 to 44 per cent. of the *whole capacity* of the vessels is occupied by the engine-room and coals. The Table also gives the most general proportion of power to tonnage as one horse-power to every three tons.

[The author next gives in Tables VI. VII.,† the particulars of several steamers, with both screw and paddle-wheel engines, from which the comparative spaces occupied by the coals and machinery may be seen. From these Tables he deduces the following important particulars.]

1st. That in Government vessels the general proportion of coal taken is 1 ton per nominal horse-power, equal to about $1\frac{1}{2}$ times the gross weight of machinery, as before given.

* From the Lond. Mechanics' Magazine, Aug., 1855.

† These and several other Tables, which occur afterwards, we are compelled to omit. We are, however, careful in all cases to give the results deduced from them, which will be sufficient for the objects of the paper.—Ed. M. M.

TABLE V.

Average Registered Tonnage.	Average Tonnage of Engine-room.	Average Total Tonnage.	Average Horse-power.	Per centage of Engine-room to Total Tonnage.	Average total Tonnage per Horse-power.
Average of 6 Side-lever Engines, P. and O. S. N. Co.					
1156	913	2069	636	44 per cent.	3.25
Average of 6 Direct-acting Engines, P. and O. S. N. Co.					
1659	854	2513	794	34 per cent.	3.16
Average of 1200 English Merchant Steamers.					
138	108	246	83	44 per cent.	2.95

2d. That the horizontal space occupied by the entire engine-room, when this proportion of coal is taken, is about $4\frac{1}{2}$ square feet per nominal horse-power.

3d. That the space occupied by the coal bunkers carrying this proportion of fuel, may be taken at 2 or $2\frac{1}{4}$ square feet per horse-power, or about three times the space occupied by the engines alone, exclusive of boilers, passages, &c.

4th. That the space occupied by the engines alone, exclusive of boilers, coal bunkers, and passages, may be taken at $\frac{3}{4}$ square feet per nominal horse-power, that is, where the engines are direct-acting.

From an average of the eighteen estimates furnished to Government by different makers, and from some other cases, it appears that the space occupied by the boilers alone may be taken at about 1 square foot per nominal horse-power, and that the total price of £43 per horse-power for the machinery may be thus divided:—

	£	s.	d.	
Engines, boilers, and coal bunkers,	38	0	0	per horse-power.
Wheels, ...	2	10	0	“ “
Spare gear, ...	2	10	0	“ “
Total,	£43	0	0	

The amount for engines, &c., may be divided nearly as follows:—

	£	s.	d.	
Engines, ...	24	0	0	per horse-power.
Boilers, ...	12	0	0	“ “
Coal bunkers, ...	2	0	0	“ “
Total,	£38	0	0	

These proportions will be quite near enough for the purpose required, and the relation they bear to each other will not be much influenced by the present increased prices. It will therefore be assumed that the cost of the engines alone is about one-half the entire cost of machinery.

It will be requisite further to consider the average *annual expense* of

the coal used by steam vessels, and its proportion to the cost of the vessels or capital; this depending partly upon the class of vessel, and partly upon the service upon which she is engaged.

[In Table VIII., the author gives an approximation to the yearly cost of coal used by five classes of vessels, with the relation it bears to their cost.]

These comparisons will be found useful when the advantages of increasing the size of the engines are considered.

The cost of coal in London is taken at 16s. per ton.

The cost of coal in Liverpool is taken at 12s. per ton.

The cost of coal for Australian vessels at an average of 60s. per ton.

The cost of coal for Eastern Steam Navigation Company at 12s. per ton.

The price of coal is sometimes above these amounts, but they are near enough to illustrate the argument intended.

For better comparison, it will be desirable to condense the results, and this Table gives us the cost of engines alone (assumed at half the total cost of machinery) in

Classes 3, 4, and 5,	at 15 per cent. of the capital;
Class 2, . . .	at 20 per cent. of the capital;
Class 1, . . .	at 30 per cent. of the capital;

Also the yearly cost of coal in

Classes 2, 3, and 5,	at say 5 per cent. of the capital;
Class 1, . . .	at say 15 per cent. of the capital;
Class 4, . . .	at say 25 per cent. of the capital;

In further illustration of this part of the subject, the subjoined accounts are added.

[In Table IX. is given by the West India Mail Steam Packet Company an account, showing the relative cost of coal, wages, &c., for 1850 and 1852, from which it appears that the cost of coals in 1850, was equal to 30 per cent. of the total working cost, and in 1852 equal to 35½ per cent.; and in Table X. is given the total actual expenses of coals, wages, &c., of the same Company for the year 1850, and the per centages of these items on the total cost of vessels.] This Table gives the cost of coals in 1850 equal to 28 per cent. of the working expenses, and nearly 13 per cent. of the total cost of vessels, and the whole working expenses at 45½ per cent. of the cost of vessels. If the mileage working expenses for 1850 be taken to amount to 45½ per cent. of the capital, then in 1852 the same expenses would be 53½ per cent., and from the respective ratios of the cost of coals to the total working expenses for those years, we have 13·74 per cent., and 19·02 per cent. as the cost of coals on the capital; consequently 15 per cent. may be fairly taken as a mean.

• These classes are as follows:—1. *River.* 2. *Continental.* 3. *American.* 4. *Australian.* 5. *Eastern Steam Navigation Company.*

For easy reference the following Table XI. is given :—

TABLE XI.

When the Annual Cost of Coal on Capital amounts respectively to						5 per cent.	15 per cent.	25 per cent.
Then 10 per cent. saving in Coal } equals }						$\frac{1}{2}$ per cent. on capital.	$1\frac{1}{2}$ per cent. on capital.	$2\frac{1}{2}$ per cent. on capital.
"	20	"	"	"	"	1 "	3 "	5 "
"	30	"	"	"	"	$1\frac{1}{2}$ "	$4\frac{1}{2}$ "	$7\frac{1}{2}$ "
"	40	"	"	"	"	2 "	6 "	10 "

As the least of these savings, in the middle column, frequently makes all the difference between a good and bad paying concern, it is quite certain that upon the expenses of the single item of coal may frequently hang the very existence of a Company.

It will be seen from the foregoing accounts, that there is little room for economizing the expenditure upon any other item, to anything like the extent possible in the item of coals alone, as the largest amount next that for coals, according to the mileage expenses, is for wages or repairs, each of these amounting to only about half the cost of the coals.

The following Tables XII., XIII., XIV., have been compiled in order to show the increased dividend on original capital which may be made by a saving in coal, owing to expansive working of the steam, the size or nominal horse-power of the engines being supposed to be increased from 1 to $1\frac{1}{2}$, 2, $2\frac{1}{2}$, and 3 times respectively, the extra cost of larger engines being proportionately allowed for, and the boilers and wheels or screw supposed to remain the same. The indicated or real horse-power is also supposed to remain the same, the larger engines being solely for the purpose of working the steam expansively. The first Table XII. is based on the supposition that the annual cost of coals is equal to 5 per cent. on the capital, and nearly agrees with the classes of vessels numbered 2, 3, and 5 in the Table VIII.

This proportionate cost of coals is here applied to cases in which the cost of the engine power (exclusive of boilers, wheels, or screw), is equal to 15 per cent. of the capital, say as in Classes 3 and 5, and also to cases in which the cost of the engine power is 20 per cent. of the capital, as in Class 2. Column A, gives the proportionate size or nominal horse-power of engines; column B, the proportionate quantity of coal required to develop an equal amount of power (in each case); column C, the proportionate cost of coal in per centage of capital; column D, the proportionate saving in cost of coal in per centage of capital, from which it appears that if the size of the engines be doubled, the saving is 1.45 per cent. on the capital, and if the size of the engines be increased to three times, the saving is 2.15 per cent. on the capital. From this saving on the item of coal, however, must be deducted the interest on the extra cost of larger engines, and this deduction will vary according to the proportionate expenses of the engines to the capital. Columns E, F, G, apply to the case in which the cost of the engines alone (exclusive of boilers, wheels, or screw) amounts to 15 per cent. of capital (as

in American vessels, and the Eastern Steam Navigation Company); and columns H, I, J, to the case in which the cost of engines alone amounts to 20 per cent. of capital, as in continental steamers, &c.; columns E and H give the necessary per centage of increase of capital; columns F and I the permanent charge on capital, being 5 per cent. allowed on the necessary addition made to it; and columns G and J, the gross gain in per centage of capital, after deducting the interest on extra cost of engines from the total gain or saving in coal. The results in this Table show that if the size of the engines be doubled, an additional 0.70 or 0.45 per cent. may be paid on capital, and that upon the engines being increased to three times the size, an additional 0.65 or 0.15 per cent. may be paid on capital, according as the cost of the engine power amounts to 15 per cent. or 20 per cent. of the capital respectively.

TABLE XII.

Table showing the Increased Dividend on Capital, by a Saving in Coal from Expansive Working; the extra Cost of larger Engines being taken into account; Boilers, Wheels, or Screw, and Indicated Horse-Power being supposed to remain the same.

Proportional Nominal Horse-Power, or size of Engines.	Proportional cost of coal for same actual Power.	ANNUAL COST OF COALS TAKEN AT FIVE PER CENT. OF CAPITAL.							
		Cost of coal in per centage of original capital.	Saving in cost of coal in per centage of original capital.	Cost of Engines alone (exclusive of Boilers, Screw, &c.) equal to 15 per cent. of Capital (say as in Classes 3 & 5).			Cost of Engines alone (exclusive of Boilers, Screw, &c.) equal to 20 per cent. of capital (say as in Class 2).		
				Increasing the Nominal horse-power, adds to Capital invested.	Permanent charge on Capital, being 5 per cent. on addition.	Gross gain on Capital, deducting amounts in F from D.	Increasing the Nominal horse-power, adds to capital invested.	Permanent charge on capital, being 5 per cent. on addition.	Gross gain on capital, deducting amounts in I from D.
		Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1	1.00	5.00	.00	7.50	.37	.57	10.00	.50	.45
1½	.81	4.05	.95	7.50	.37	.57	10.00	.50	.45
2	.71	3.55	1.45	15.00	.75	.70	20.00	1.00	.45
2½	.63	3.15	1.85	22.50	1.12	.72	30.00	1.50	.35
3	.57	2.85	2.15	30.00	1.50	.65	40.00	2.00	.15
A	B	C	D	E	F	G	H	I	J

The second Table, XIII., is constructed in the same manner as the first, the annual cost of coals being taken at 15 per cent. of the capital, which, as before mentioned, applies to the class of vessels marked 1, and the West India Mail boats. This annual cost of coals is applied to the cases in which the cost of engines (exclusive of boilers, wheels, or screw), amounts to 20 per cent. of the capital, and also to the cases in which the cost of engines alone amounts to 30 per cent. of the capital; the general results are, that if the engines be increased to double the size, for the sake of expansive working, the saving of coal would be 4.35 per cent. of capital, and if the engines be increased to three times the size, the saving in coal would be 6.45 per cent. of capital. These amounts are reduced by the extra cost of engines respectively to 3.55 per cent. and 2.85 per cent. of capital, and to 4.45 per cent. and 3.45 per cent. of capital, according as the cost of engine power amounts to 20 per cent. or 30 per cent. of capital.

The third Table, XIV., is constructed in the same manner as the two former ones, the annual cost of coals being taken at 25 per cent. of the

capital, which, as shown before, applies to the Australian vessels, or class 4, where the cost of engines alone (exclusive of boilers, wheels, or screw), is equal to about 15 per cent. of capital. The results are, that if the size of the engines be doubled for expansive working, the saving of coal would amount to 7·25 per cent. of capital, and if increased to three times the size, the saving of coal would amount to 10·75 per cent. of capital. These amounts are reduced by the extra cost of engines to 6·50 per cent. and 9·25 per cent. of capital.

TABLE XIII.

Table showing the Increased Dividend by a Saving in Coal from Expansive Working, the extra Cost of larger Engines being taken into account; Boilers, Wheels, or Screw, and Indicated Horse-Power being supposed to remain the same.

ANNUAL COST OF COALS TAKEN AT FIFTEEN PER CENT. OF CAPITAL.									
Proportional Nominal horse-power, or size of Engines.	Proportional cost of coal for same actual power.	Cost of coal in per cent. of original capital.	Saving in cost of coal in per cent. of original capital.	Cost of Engines alone (exclusive of Boilers, Screw, &c.) equals 20 per cent. of capital, (as in West India Mail Boats.)			Cost of Engines alone (exclusive of Boilers, Screw, &c.) equals 20 per cent. of capital, (as in River Boats, Class 1.)		
				Increasing the Nominal horse-power adds to capital invested.	Permanent charge on capital, being 5 per cent. on addition.	Gross gain on capital, deducting amounts in F from D	Increasing Nominal horse-power, adds to capital invested.	Permanent charge on capital, being 5 per cent. on addition.	Gross gain on capital, deducting amounts in I from D.
		Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1	1·00	15·00	..	..	..	..	..	..	..
1½	·81	12·15	2·85	10	·50	2·35	15	·75	2·10
2	·71	10·65	4·35	20	1·00	3·35	30	1·50	2·85
2½	·63	9·45	5·55	30	1·50	4·05	45	2·25	3·30
3	·57	8·55	6·45	40	2·00	4·45	60	3·00	3·45
A	B	C	D	E	F	G	H	I	J

TABLE XIV.

Table showing the Increased Dividend by a Saving in Coal from Expansive Working, the extra Cost of Larger Engines being taken into account; Boilers, Wheels, or Screw, and Indicated Horse-Power being supposed to remain the same.

ANNUAL COST OF COALS TAKEN AT 25 PER CENT. OF CAPITAL.						
Proportional nominal Horse-Power, or size of Engines.	Proportional cost of coal for same actual power.	Cost of coal in per cent. of original capital.	Saving in cost of coal in per cent. of original capital.	Cost of Engines alone (exclusive of Boilers, Screw, &c.) equal to 15 per cent. of capital, (as in Australian Vessels, Class 4.)		
				Increasing the Nominal Horse-power, adds to capital invested.	Permanent charge on capital, on addition.	Gross gain on capital, deducting the amounts in F from D.
		Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1	1·00	25·00	..	..	..	..
1½	·81	20·25	4·75	7·50	·37	4·38
2	·71	17·75	7·25	15·00	·75	6·50
2½	·63	15·75	9·25	22·50	1·12	8·13
3	·57	14·25	10·75	30·00	1·50	9·25
A	B	C	D	E	F	G

It is evident that the dearer the coal is, or the larger the quantity consumed in proportion to the actual power developed, the more advantageous would be the saving effected by expansive working, as the percentage of saving in coal would the sooner cover any extra cost of engines; and the foregoing Tables clearly show that if the size of the engines be increased to *three* times for expansive working, and their *cost* be consequently *doubled*, there yet remains a gain, under the worst circumstances, of $\cdot 15$ per cent. on capital, and under favorable circumstances, such as those presented by the Australian vessels, of $9\frac{1}{4}$ per cent. on capital.*

(To be continued.)

TWENTY-FIFTH MEETING OF THE BRITISH ASSOCIATION FOR THE
ADVANCEMENT OF SCIENCE.†

On the Condition of the Atmosphere during Cholera. By Dr. R. D. THOMSON.—The chemical condition of cholera atmospheres is a question of intense interest in the subject of public health; but, with the exception of the unpublished experiments of Dr. Prout, in 1832, comparatively little attention appears to have been bestowed on it. One of the most striking circumstances connected with the occurrence of the disease is, that no change very palpable to the senses prevails, and even one may have remarked that the weather has usually been exceedingly agreeable. In London, at St. Thomas's Hospital, the neighborhood of which afforded a large supply of cholera cases, the relative weight of the air in August, 1854, a cholera month, and in August, 1855, when the metropolis was in an extremely healthy condition, is exhibited in the following table, in grains per cubic foot:—

1854. Weight of Cubic F. in grains.				1855. Weight of Cubic Ft. in grains.			
Week ending				Week ending			
August	5	..	522.9 grains	August	4	..	516.9 grains
"	12	..	526.7 "	"	11	..	524.3 "
"	19	..	595.0 "	"	18	..	525.9 "
"	26	..	523.5 "	"	25	..	519.2 "
Sept.	2	..	525.1 "	Sept.	1	..	523.0 "
"	9	..	530.3 "	"	8	..	531.6 "
Mean	..		525.6 "	Mean	..		523.5 "

The result, as deduced from this table, which has been calculated approximately from the barometric pressure and dry and wet bulb thermometer, is analogous to that obtained by Dr. Prout, in 1832, as the author was informed by himself. Corresponding observations have been made at Greenwich by Mr. Glaisher, and the same conclusions arrived at; from which it would appear that this superior weight of a given bulk

* It has not been considered necessary to include more than the five classes of vessels in the foregoing Tables, although many other classes exist, in which the proportionate cost of coal and machinery vary from the amounts given. In order, however, to ascertain what advantages would be gained by the substitution of larger engines in any specific case, it will only be necessary to substitute the correct amounts in place of those given above.

† From the Lond. Athenæum, September, 1855.

of air was not a local phenomenon, but was diffused to considerable distances, and the character distinguishing September, 1854, from the corresponding period in 1855, was the absence of any atmospheric action on ozone test-paper in the former season, while during the present year the oxidizing influence of the air has never been absent at St. Thomas's Hospital. During September, 1854, however, when no ozone could be detected in London, its action was sometimes faintly and often very strongly marked at Lewisham, near Greenwich. Throughout the same periods the air was exceedingly stagnant: and it has since been observed by Mr. Glaisher, and also at Vienna, that rapid atmospheric movement is pretty constantly accompanied by an oxidizing condition of the air. With reference to the chemical composition in the atmosphere of inhabited localities and of malarious districts, experiments have usually been conducted on the constitution of the gases which enter into the composition of the air. But the results seem to have thrown little light on the possibility of the production, from such causes, of any disease characterized by a regular sequence of symptoms. So far as our knowledge warrants, gases can either act only as asphyxiating media by the exclusion of oxygen, or as slow or rapid poisons. The cause capable of inducing a disease formed on a peculiar type, analogy leads us to infer must be an organized condition, either in a solid form or in a finely diffused or vaporific state. The fact observed, that in malarious atmospheres sulphuric acid speedily becomes black, also points to the propriety of examining the air in such situations with the view of filtering from it solid or condensable matter. In the epidemic of 1849-50, the author examined the exterior air of an infected district with this object in view to the extent of many cubic feet, but the result was comparatively negative, and led to the inference that the examination of large masses of air could alone hold out any prospect of a successful issue. For this purpose air was passed through carefully prepared distilled water contained in Woulfe's bottles by means of a large aspiratory apparatus of the capacity of 16 cubic feet, which was kept constantly in action during the day for several months. Occasionally, freezing mixtures were applied to portions of the apparatus, and a tube filled with pumice moistened with sulphuric acid placed next the aspirator completed the series. A range of tubes conducted the air from a cholera ward into the aspirator. The ward was 32 feet long, 20 feet wide, and 9 feet high. The air was drawn from the centre of the ward near the ceiling; and when the apartment was filled with cholera patients, the air, after traversing several layers of distilled water, was speedily cleared by the sulphuric acid, and deposited a variety of solids in all the Woulfe's bottles, which could even be detected in some measure by the eye. The objects consisted of blue and red cotton fibres from the dresses of the inmates, portions of hair, wool, fungi, sporules of fungi, abundance of vibriones or lower forms of animal life, with particles of silica and dirt. In this and all the experiments conducted on the air of closed apartments, the distilled water was rendered strongly acid from the presence of sulphuric and sulphurous acids derived from the products of gas and coal combustion. The distilled water employed in these experiments was boiled for some time previous to being introduced into the apparatus, and was divided

into two portions; one part being placed in a stopped bottle beside the Woulfe's bottles through which the air was conducted, the sediment, if any, being afterwards examined and compared with that resulting from the experiment. When the ward was partially full, vegetable epiderm, vegetable cellular tissue, fragments of wool, cotton, linen, vegetable hairs, a sponge spicula, minute fungi, spiral vessels, sporules, spore cases, animal epithelium, oil globules, and silicious particles were detected,—while vibriones were entirely absent, or at least mere traces could be discriminated. This is an interesting result, since in the first case only 98·6 cubic feet were examined, and of the partially empty ward, 240 cubic feet passed through the apparatus. When the ward was empty, cotton fibres, wool, a trace of fungus with carbonaceous and silicious particles were alone discernible,—the amount of air examined being 304 cubic feet. The air external to the ward and in the immediate neighborhood afforded from 560 cubic feet one cotton fibre, one of wool, a crystalline body—probably a sponge spicula, sporules, beautiful mycelia of fungi in various stages of development, and some carbonaceous matter. The distilled water in this instance likewise yielded a strongly acid reaction, produced by sulphur acids. The possible influence of sewer atmospheres predicated interesting results from an examination of such air,—and accordingly it was found that the predominating feature of this experiment, was animal life in the form of swarms of vibriones in various stages of advancement. The chemical re-action in this case, unlike that in the preceding experiments, was invariably alkaline, due to the evolution of ammonia from the nitrogenous matters contained in the sewage liquors. These experiments render it sufficiently obvious that organic living bodies constantly surround us in close apartments, and particularly that animal matter under certain circumstances is likewise diffused through such atmospheres. They fail to point out any matter capable of communicating cholera from one individual to another through the medium of the air, and therefore are so far important to the public; but they show that foreign animal matter injurious to health may speedily be concentrated in certain localities, which will undoubtedly assist in the production and propagation of disease in conjunction with meteorological conditions. Pathological investigations carefully conducted by the author's colleague, Mr. Rainey, detected in one case an entozoon in the glottis or upper part of the air-passage, the only analogue of which has been found in the substance of the muscle of animals, which would seem to indicate that the germ of this creature had been derived from the atmosphere, or at least from external sources. It is intended that these experiments, which are tedious and laborious in their character, shall be extended to other atmospheres, so as to obtain comparative series of views, so to speak, of air modified by the influence of different diseases.

On Papyrus Bonaparteæ, and other Plants which can furnish Fibre for Paper Pulp. By Chevalier DE CLAUSSEN.—The paper makers are in want of a material to replace rags in the manufacture of paper, and I have therefore turned my attention to this subject, the result of which I will communicate to the Association. To make this matter more comprehensible I will explain what the paper-makers want. They require a cheap material, with a strong fibre, easily bleached, and of which an

unlimited supply may be obtained. I will now enumerate a few of the different substances which I have examined for the purpose of discovering a proper substitute for rags. Rags containing about 50 per cent. of vegetable fibre mixed with wool or silk are regarded by the paper-makers as useless to them, and several thousand tons are yearly burned in the manufacture of prussiate of potash. By a simple process which consists in boiling these rags in caustic alkali, the animal fibre is dissolved, and the vegetable fibre is available for the manufacture of white paper pulp. Surat, or Jute, the inner bark of *Corchorus indicus*, produces a paper pulp of inferior quality bleached with difficulty. Agave, *Phormium tenax*, and Banana or plantain fibre (Manilla hemp), are not only expensive, but it is nearly impossible to bleach them. The banana leaves contain forty per cent. of fibre. Flax would be suitable to replace rags in paper manufacture, but the high price and scarcity of it, caused partly by the war, and partly by the injudicious way in which it is cultivated, prevents that. Six tons of flax straw are required to produce one ton of flax fibre, and by the present mode of treatment all the woody part is lost. By my process the bulk of the flax straw is lessened by partial cleaning before retting, whereby about 50 to 60 per cent. of shoves (a most valuable cattle food) are saved, and the cost of the fibre reduced. By the foregoing it will be seen that the flax plant only produces from 12 to 15 per cent. of paper pulp. All that I have said about flax is applicable to hemp, which produces 25 per cent. of paper pulp. Nettles produce 25 per cent. of a very beautiful and easily bleached fibre. Palm-leaves contain 30 to 40 per cent. fibre, but are not easily bleached. The Bromeliaceæ contain from 25 to 40 per cent. fibre. *Bonaparteia juncoidea* contains 35 per cent. of the most beautiful vegetable fibre known; it could not only be used for paper pulp, but for all kinds of manufactures in which flax, cotton, silk, or wool are employed. It appears that this plant exists in large quantities in Australia, and it is most desirable that some of our large manufacturers should import a quantity of it. The plant wants no other preparation than cutting, drying, and compressing like hay. The bleaching and finishing may be done here. Ferns give 20 to 25 per cent. fibre, not easily bleached. *Equisetum* from 15 to 20 per cent. inferior fibre, easily bleached. The inner bark of the lime-tree (*Tilia*) gives a fibre easily bleached, but not very strong. Althea and many Malvacæ produce from 15 to 20 per cent. paper pulp. Stalks of beans, peas, hops, buckwheat, potatoes, heather, broom, and many other plants contain from 10 to 20 per cent. of fibre,—but their extraction and bleaching present difficulties which will probably prevent their use. The straws of the Cereals cannot be converted into white paper pulp after they have ripened the grain; the joints or knots in the stalks are then so hardened that they will resist all bleaching agents. To produce paper pulp from them they must be cut green before the grain appears, and this would probably not be advantageous. Many grasses contain from 30 to 50 per cent. of fibre, not very strong, but easily bleached. Of indigenous grasses, the Rye grass contains 35 per cent. of paper pulp; the *Phalaris* 30 per cent.; *Arrhenatherum* 30 per cent.; *Dactylis* 30 per cent.; and *Carex* 30 per cent. Several reeds and canes contain from 30 to 50 per cent. of fibre, easily bleached. The stalk of the sugar-cane gives

40 per cent. of white paper pulp. The wood of the Coniferea gives a fibre suitable for paper pulp. I made this discovery accidentally in 1851, when I was making flax cotton in my model establishment at Stepney, near London. I remarked that the pine wood vats in which I bleached were rapidly decomposed on the surface into a kind of paper pulp; I collected some of it, and exhibited in the Great Exhibition,—but as at that time there was no want of paper material no attention was paid to it. The leaves and top branches of Scotch fir produce 25 per cent. of paper pulp. The shavings and sawdust of wood from Scotch fir gives 40 per cent. pulp. The cost of reducing to pulp and bleaching pine wood, will be about three times that of bleaching rags. As none of the above named substances or plants, would entirely satisfy on all points the wants of the paper-makers, I continued my researches, and at last remembered the papyrus (the plant of which the ancients made their paper), which I examined, and found to contain about 40 per cent. of strong fibre, excellent for paper, and very easily bleached. The only point which was not entirely satisfactory was relative to the abundant supply of it, as this plant is only found in Egypt. I directed, therefore, my attention to plants growing in this country; and I found to my great satisfaction that the common rushes (*Juncus effusus* and others) contain 40 per cent. of fibre, quite equal, if not superior, to the papyrus fibre, and a perfect substitute for rags in the manufacture of paper, and that one ton of rushes contains more fibre than two tons of flax straw.

On the Hancornia speciosa, Artificial Gutta Percha and India Rubber.—By the Chevalier DE CLAUSSEN.—In the course of my travels as botanist in South America, I had occasion to examine the different trees which produce the india rubber, and of which the *Hancornia speciosa* is one. It grows on the high plateaux of South America, between the tenth and twentieth degrees of latitude south, at a height from three to five thousand feet above the level of the sea. It is of the family of the Sapotaceæ, the same to which belongs the tree which produces gutta percha. It bears a fruit, in form not unlike a bergamot pear, and full of a milky juice, which is liquid india rubber. To be eatable this fruit must be kept two or three weeks after being gathered, in which time all the india rubber disappears or is converted into sugar, and is then in taste one of the most delicious fruits known, and regarded by the Brazilians (who call it Mangava) as superior to all other fruits of their country. The change of india rubber into sugar, led me to suppose that gutta percha, india rubber, and similar compounds contained starch. I have therefore tried to mix it with resinous or oily substances, in combination with tannin, and have succeeded in making compounds which can be mixed in all proportions with gutta percha or india rubber without altering their characters. By the foregoing it will be understood that a great number of compounds of the gutta percha and india rubber class may be formed by mixing starch, gluten, or flour with tannin and resinous or oily substances. By mixing some of these compounds with gutta percha or india rubber, I can so increase its hardness that it will be like horn, and may be used as shields to protect the soldiers from the effect of the Minie balls, and I have also no doubt that some of these compounds in combination with iron, may be useful in floating batteries, and many other purposes, such

as the covering the electric telegraph wires, imitation of wood, ship-building, &c.

On the Employment of Algæ, and other Plants in the Manufacture of Soaps. By the Chevalier DE CLAUSSEN.—When I was experimenting on several plants for the purpose of discovering fibres for paper pulp, I accidentally treated some common sea-weeds with alkalies, and found they were entirely dissolved, and formed a soapy compound which could be employed in the manufacture of soap. The making of soaps directly from sea-weeds must be more advantageous than burning them for the purpose of making kelp, because the fucoid and glutinous matter they contain are saved and converted into soap. The Brazilians use a malvaceous plant (*Sida*) for washing instead of soap, and the Chinese use flour of beans in the scouring of their silk; and I have found that not alone sea-weed, but also many other glutinous plants, and gluten, may be used in the manufacture of soap with advantage.

The Section resumed discussion of the subject of "*Artillery and Projectiles*," when

Dr. SCORESBY stated, as the result of experiments he had made, that the quality of iron might be effectually tested by its effect in counteracting the deviation produced on a compass by a magnet placed in opposition to it.—Mr. NEILSON, iron-founder, gave, as the result of his experience, that, if repeatedly heated, or heated without being subjected to severe hammering or pressure, the centre of a mass of iron was sure to become crystalline and friable.—Mr. RENNIE thought the defects of the artillery of the present day were, in a great degree, to be attributed to the competition in cheapness among manufacturers.—Mr. WESTERN suggested the appointment of a committee to collect information on the subject from practical men.—The DUKE of ARGYLL expressed the obligation the Government would be under to such a committee for the information it might collect.—Sir E. BELCHER stated that, in engagements which he had witnessed, much more severe than that of Sweaborg, no accidents whatever had occurred to the ordnance. He suggested the employment of guns similar to those of the Chinese, with strong cast iron breeches, the direction tube being a matter of little moment.

On the Effects of Screw Propellers when moved at different Velocities and Depths. By Mr. G. RENNIE.—From experiments which had been made under his observation, it was desirable that the screws of vessels should be of small dimensions, light, and of rapid motion, and that their effect would be increased by their being as deeply immersed as possible. He also recommended the disk screw.

Several Members questioned the effect attributed in the paper, to deep immersion.

On a Momentum Engine for Steam or Water. By Mr. W. GORMAN.—The principle of which was the direction of a strong jet of steam into the buckets of a wheel, which were to be so constructed and placed as to render every particle of the force of the jet serviceable. The engine seemed to be suitable for cases where rapid motion was necessary without great force.

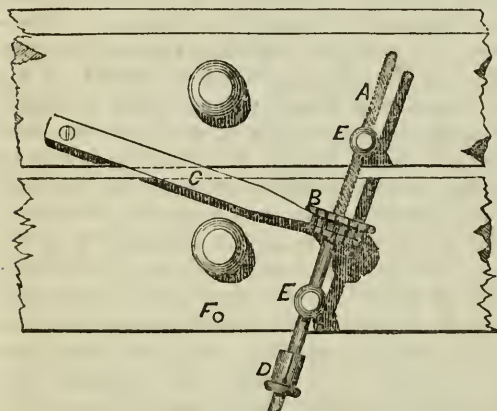
On the Relation between Revolving Storms and Explosions in Coal Mines. By Mr. T. DOBSON.—Many observations were made in several

parts of Great Britain, which seemed to establish an intimate relation between revolving storms and barometric changes; and that explosions were most frequent when the barometer is falling and the wind southerly, while they never occurred when the barometer stood high, and at the same time the wind north. The paper was illustrated by a carefully executed storm map.

Dr. ROBINSON suggested the appointment of an inspector of mines with respect to the state of the gases, temperature, &c., so that proper precautions might be used to prevent accidents. This, he thought, would be the only practical benefit to be derived from the experiments of Mr. Dobson.

A New Parallel and Radial Rule. By E. T. LOSEBY.*

The accompanying engraving represents the middle of the rule, containing the improved portions; the ends being of the ordinary construction, they are omitted.



A is a straight steel wire, made into a screw at one end, on which is fixed a nut, B, milled on the edges and divided into ten notched divisions, which admit the end of the steel spring, C, and prevent the screw being accidentally moved; the spring is made to travel with the screw, by its acting in a groove sunk in the nut; D, a clamp, milled on the edge, which is slit to make it move tightly and evenly along the wire; the

audible sound which the spring makes in falling into the notches enables them to be counted by ear to relieve the eye; whole turns are counted by a mark placed on the nut, and every tenth turn by a notch in the wire. EE, two studs, screwed into the rule, in one of which the screw works and the other forms a stop, which, limiting the range of the clamp, D, regulates the distance the rule opens; the holes in the studs are a little elongated horizontally, to allow of the wire accommodating itself to the motion of the rule; the wire being placed at the best angle with the joint arms for reducing the motion to the lowest amount.

The screw should be of the proper pitch to open the rule $\frac{1}{100}$ of an inch each revolution, which it would do with 100 turns to the inch if placed at a right angle with the rule, but as the proper angle is rather less, the screw requires to be proportionably coarser, in order that each division on the nut may be equal to $\frac{1}{100}$ of an inch, each turn to $\frac{1}{100}$, and each notch on the wire to $\frac{1}{100}$.

* From the Lond. Journ. of the Society of Arts, No. 155.

In setting the rule to open accurately a particular distance, the nut, *n*, is screwed forward close to the screw-stud, and the clamp, *c*, pressed along the wire to the stop-stud, so as to keep the rule quite close without it being strained. The marked division on the nut should now be uppermost, and the clamp at the zero notch on the wire; the nut is then unscrewed the requisite number of turns and parts of a turn, to accord with the number of tenths, hundredths, and thousandths of an inch required. For less accurate purposes, the clamp may be set to the proper division on the wire by the eye, without it being screwed home, the object of which is to ensure perfect contact of the bearings.

The rule is converted from a parallel to a radial rule by a point placed at *F*, and a small hole, not shown in the drawing, drilled in the line of the straight-edge at the end towards the left hand, through which, and the centre of the circle to be divided, a pin is driven into the drawing-board; the rule being then opened and closed in the ordinary way by a finger placed on each of the studs, it is constrained by the points to move round in a circle.

One of the finger-studs is made to serve for the point by screwing it into the hole, *F*, and the rule being thinner towards the edge, it allows the point to project sufficiently there without projecting when placed in the other hole for drawing parallel lines; the studs are milled on the edge to facilitate their being unscrewed with the fingers.

The different parts should be so proportioned and arranged that when the back point is placed at *F*, so as to be convenient for the fingers, the two points will remain at the same distance from each other, and simply revolve whilst the rule is being opened and closed, and that ten turns of the screw will be equal to 1° . Both these conditions can be fulfilled if the proper size and position of the following parts are observed, viz:—the distance between the two points, and the distance of *F* from the straight-edge; the length of the joint-arms from centre to centre, and the angle they are placed at on the rule.

Amongst the uses of the rule the following may be mentioned:—

For drawing any number of lines at equal distances—as, for example, those in sectional drawing, shading, flights of steps, screw threads, laying on a tint of equal lines similar to engravers' machine-ruling, ruling paper for tables, writing, &c.

For drawing lines at increasing or diminishing distances—as, for instance, giving the position, without individual measurement, of doors, windows, columns, &c., in a range of buildings seen in perspective; the position of wheel-teeth seen edgewise, &c.

For graduating straight scales of divisions either at equal distances, as those of thermometers, &c., or at accumulating distances, as those of hydrometers.

For drawing radial lines round a circle, either at equal distances or at increasing or diminishing distances.

For dividing circular scales into equal or accumulating spaces, laying down angles, &c.

A gauge for short distances, giving micrometer measurements.

It would add to the security of the rule in drawing parallel lines if four pointed screws, similar to the one used at *F*, were placed at the

corners to diminish the risk of its slipping ; but for very accurate work, such as engravers', this may be more effectually done by fixing the back of the rule to the drawing-table frame, or board with pins, reversing the clamp, D, and placing it to act on the other side of the stop-stud, and working the front half of the rule by the screw alone. This arrangement will allow a tool to be pressed against the straight-edge with sufficient force for engraving wood blocks or steel plates.

One or two other things remain to be noticed which apply to ordinary rules as well as to those above described. First, they should have disks of thin metal between the joint arms and the rule, to prevent any rubbing at a distance from the rivets. Secondly, the straight-edge should be of steel, hardened and tempered to resist the action of tools drawn along it ; the steel, which is cheaply prepared for ladies' stays, answers very well ; it may be fixed by being cemented into a groove in the rule. Thirdly, the rule, instead of being flat on the under side, as they are usually made, should be slightly bevelled towards both edges, so as to divide the width into three equal bearings ; this effects two objects, one of which is to make the rule easier to work and less liable to shift accidentally, as when one side is pressed down it raises the other, and keeps it quite free whilst it is being moved ; the other object is to enable the same straight-edge to be raised different distances from the paper whilst drawing the lines by pressing down the front, middle, or back of the rule.

As several years have elapsed since the construction was completed and arranged in the present form, after several others that occurred to me had been tried, and as improvements in mathematical instruments very seldom repay the heavy cost of a patent, the construction is now open for any one to manufacture ; but in order to afford further facility for its being properly carried out, I have furnished detailed instructions to the principal mathematical instrument makers, who are making arrangements for supplying the improved rules to the public ; having done thus much in the matter and occupied several months with the rule at different times, it must rest with them whether it is perfectly manufactured or not.

*Magnetic Gauge for Steam Boilers.**

This is said to be the first application of magnetism to steam-boilers. The apparatus consists of a metallic hollow spheroid suspended by an iron rod, the end of which is a bar of steel strongly magnetised. This magnet rises and falls in a brass box, which serves as a sort of cage to enclose it. Upon the face of this box, which is graduated in centimetres or inches, moves a small needle or pointer, separated from all mechanical support, but attracted only through the loop of the magnet, all of whose motions it follows. The extreme limits of the floating ball can only be reached by touching the stops which open the alarm-whistle, so that a failure or an over-supply of water is immediately detected. The graduated surface of the gauge is silvered, so that the continual motion of the pointer is readily seen at any distance.

* From the London Artizan, February, 1856.

The apparatus is protected by a glass cover, which preserves the needle from injury and keeps the graduated scale constantly clean.

The price of the gauge, without the valve, is from 170 to 180 francs, and the gauge and whistle from 30 to 90 francs extra.

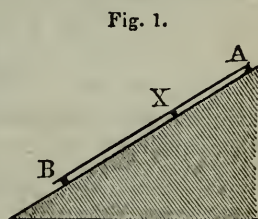
This gauge is merely a bad copy of Faber's Magnetic Gauge, patented in this country, and described in this *Journal*, (present Series,) Vol. xxi, p. 215. The Faber Gauge is very superior to the one exhibited at the French Exhibition, which has been altered merely to disguise the theft, and has no novelty but its defects.

EDITOR.

On the Descent of Glaciers. By the Rev. HENRY MOSELEY, M.A, F.R.S.*

If we conceive two bodies of the same form and dimensions (cubes for instance,) and of the same material, to be placed upon a uniform horizontal plane, and connected by a substance which alternately extends and contracts itself, as does a metallic rod when subjected to variations of temperature, it is evident that by the extension of the intervening rod, each will be made to recede from the other by the same distance, and, by its contraction, to approach it by the same distance. But if they be placed on an inclined plane (one being lower than the other), then when by the increased temperature of the rod its tendency to extend becomes sufficient to push the lower of the two bodies downwards, it will not have become sufficient to push the higher upwards. The effect of its extension will therefore be to cause the lower of the two bodies to descend whilst the higher remains at rest. The converse of this will result from contraction; for when the contractile force becomes sufficient to pull the upper body down the plane it will not have become sufficient to pull the lower up it. Thus, in the contraction of the substance which intervenes between the two bodies, the lower will remain at rest whilst the upper descends. As often, then, as the expansion and contraction is repeated the two bodies will descend the plane until, step by step, they reach the bottom.

Suppose the uniform bar AB placed on an inclined plane, and subject to extension from increase of temperature, a portion XB will descend, and the rest XA will ascend; the point X where they separate being determined by the condition that the force requisite to push XA up the plane is equal to that required to push XB down it.



Let $AX=x$, $AB=L$, weight of each linear unit= u , i =inclination of plane, ϕ =limiting angle of resistance,

$$\therefore ux = \text{weight of } AX,$$

$$u(L-x) = \text{weight of } BX.$$

Now, the force acting parallel to an inclined plane which is necessary to push a weight w up it, is represented by

$$w \frac{\sin(\phi + i)}{\cos \phi};$$

* From the Lond., Edin., and Dub. Philos. Mag., July, 1855.

and that necessary to push it down the plane by

$$w \frac{\sin(\phi - i)}{\cos \phi};$$

$$\therefore ux \frac{\sin(\phi + i)}{\cos \phi} = u(L - ux) \frac{\sin(\phi - i)}{\cos \phi}$$

$$\therefore x \{ \sin(\phi + i) + \sin(\phi - i) \} = L \sin(\phi - i)$$

$$\therefore x \sin \phi \cos i = L \sin(\phi - i)$$

$$\therefore x = \frac{1}{2} L \frac{\sin(\phi - i)}{\sin \phi \cos i}$$

$$\therefore x = \frac{1}{2} L \left\{ 1 - \frac{\tan i}{\tan \phi} \right\}.$$

Fig. 2.



When contraction takes place the converse of the above will be true. The separating point x will be such, that the force requisite to pull xB up the plane is equal to that required to pull AX down it. Bx is obviously in this case equal to AX in the other.

Let λ be the elongation per linear unit under any variation of temperature; then the distance which the point B (see fig. 1) will be made to

descend by this elongation.

$$\begin{aligned} &= \lambda \cdot BX \\ &= \lambda (L - x) \\ &= \frac{1}{2} \lambda L \left(1 + \frac{\tan i}{\tan \phi} \right). \end{aligned}$$

If we conceive the bar now to return to its former temperature, contracting by the same amount (λ) per linear unit; then the point B (fig. 2) will by this contraction be made to ascend through the space

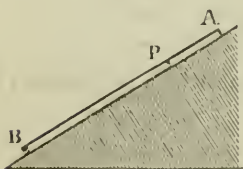
$$BX \cdot \lambda = x \lambda$$

$$= \frac{1}{2} L \lambda \left\{ 1 - \frac{\tan i}{\tan \phi} \right\} \quad \dots \dots \dots (1)$$

Total descent l of B by elongation and contraction is therefore determined by the equation

$$l = L \lambda \frac{\tan i}{\tan \phi} \quad \dots \dots \dots (2)$$

Fig. 3.



To determine the pressure upon a nail, driven through the rod at any point P fastening it to the plane.

It is evident that in the act of extension the part BP of the rod will descend the plane and the part AP ascend; and conversely in the act of contraction; and that in the former case the nail n will sustain a pressure upwards equal to that necessary to cause BP to descend, and

a pressure downwards equal to that necessary to cause PA to ascend; so

that, assuming the pressure to be downwards, and adopting the same notation as before, except that AP is represented by ρ , AB by a , and the pressure upon the nail (assumed to be downwards) by P , we have in the case of extension

$$P = u \rho \frac{\sin(\phi + i)}{\cos \phi} - u(a - \rho) \frac{\sin(\phi - i)}{\cos \phi},$$

and in case of contraction

$$P = u(a - \rho) \frac{\sin(\phi + i)}{\cos \phi} - u \rho \frac{\sin(\phi - i)}{\cos \phi}.$$

Reducing, these formulæ become respectively

$$P = \frac{u}{\cos \phi} \left\{ 2\rho \sin \phi \cos i - a \sin(\phi - i) \right\} \quad . \quad . \quad (3)$$

$$P = \frac{u}{\cos \phi} \left\{ a \sin(\phi + i) - 2\rho \sin \phi \cos i \right\} \quad . \quad . \quad (4)$$

My attention was first drawn to the influence of variations in temperature to cause the descent of a lamina of metal resting on an inclined plane, by observing, in the autumn of 1853, that a portion of the lead which covers the south side of the choir of the Bristol Cathedral, which had been renewed in the year 1851, but had not been properly fastened to the ridge beam, had descended bodily 18 inches into the gutter; so that if plates of lead had not been inserted at the top, a strip of the roof of that length would have been left exposed to the weather. The sheet of lead which had so descended measured, from the ridge to the gutter, 19 feet 4 inches and along the ridge 60 feet. The descent had been continually going on, from the time the lead had been laid down. An attempt made to stop it by driving nails through it into the rafters had failed. The force by which the lead had been made to descend, whatever it was, had been found sufficient to draw the nails.* As the pitch of the roof was only $16\frac{1}{2}^\circ$, it was sufficiently evident that the weight of the lead alone could not have caused it to descend. Sheet lead, whose surface is in the state of that used in roofing, will stand firmly upon a surface of planed deal when inclined at an angle of 30° ,† if no other force than its weight tends to cause it to descend. The considerations which I have stated in the preceding articles led me to the conclusion that the daily variations in the temperature of the lead, exposed as it was to the action of the sun by its southern aspect, could not but cause it to descend considerably, and the only question which remained on my mind was, whether this descent could be so great as was observed. To determine this I took the following data:—

* The evil was remedied by placing a beam across the rafters near the ridge, and doubling the sheets round it, and fixing their ends with spike nails.

† This may easily be verified. I give it as the result of a rough experiment of my own. I am not acquainted with any experiments on the friction of lead made with sufficient care to be received as authority in this matter. The friction of copper on oak has, however, been determined by General Morin to be 0.62, and its limiting angle of resistance $31^\circ 48'$; so that if the roof of Bristol Cathedral had been inclined at 31° instead of 16° , and had been covered with sheets of copper resting on oak boards, instead of sheets of lead resting on deal, the sheeting would not have slipped by its weight only.

Mean daily variation of temperature at Bristol in the month of August, assumed to be the same as at Leith (Kaemtz, *Meteorology*, by Walker, p. 18,) $8^{\circ}\cdot 21$ Cent.

Linear expansion of lead through 100° Cent. $\cdot 0028436$.

Length of sheets of lead forming the roof from the ridge to the gutter 232 inches.

Inclination of roof $16^{\circ} 32'$.

Limiting angle of resistance between sheet lead and deal 30° .

Whence the mean daily descent of the lead, in inches, in the month of August, is determined by equation (2) to be

$$l = 232 \times \frac{8^{\circ}\cdot 21}{100} \times \cdot 0028436 \times \frac{\tan 16^{\circ} 32'}{\tan 30^{\circ}}$$

$$l = \cdot 027848 \text{ inches.}$$

The average daily descent gives for the whole month of August a descent of $\cdot 863288$. If the average daily variation of temperature of the month of August had continued throughout the year, the lead would have descended $10\cdot 19148$ inches every year. And in the two years from 1851 to 1853 it would have descended $20\cdot 38296$ inches. But the daily variations of atmospheric temperature are less in the other months of the year than in the month of August. For this reason, therefore, the calculation is in excess. For the following reasons it is in defect:—1st, the daily variations in the temperature of the lead cannot but have been greater than those of the surrounding atmosphere. It must have been heated above the surrounding atmosphere by radiation from the sun in the day-time, and cooled below it by radiation into space at night. 2dly, One variation of temperature only has been assumed to take place every twenty-four hours, viz: that from the extreme heat of the day to the extreme cold of the night; whereas such variations are notoriously of constant occurrence during the twenty-four hours. Each cannot but have caused a corresponding descent of the lead, and their aggregate result cannot but have been greater than if the temperature had passed uniformly (without oscillations backwards and forwards) from one extreme to the other.

These considerations show, I think, that the causes I have assigned are sufficient to account for the fact observed. They suggest, moreover, the possibility that results of importance in meteorology may be obtained from observing with accuracy the descent of a metallic rod thus placed upon an inclined plane. That descent would be a measure of the aggregate of the changes of temperature to which the metal was subjected during the time of observation. As every such change of temperature is associated with a corresponding development of mechanical action under the form of work,* it would be a measure of the aggregate of such changes and of the work so developed during that period; and relations might be found between measurements so taken in different equal periods of times, successive years for instance, tending to the development of new meteorological laws.†

* Mr. Joule has shown (*Phil. Trans.* 1850, Part I.) that the quantity of heat capable of raising a pound of water by 1° Fahr. requires for its evolution 772 units of work.

† The remainder of this paper, in which these principles are applied to the explanation of glacier motion, is founded on a misconception and is fallacious. It has therefore been omitted.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, February 21st, 1856.

John C. Cresson, President, in the chair.

John Agnew, Vice President.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Letters were read from the Royal Society and the Zoological Society, London, and from the Regents of the University of the State of New York.

Donations to the Library were received from the Royal Institution, the Zoological Society, the Institute of Actuaries, and the Society of Arts, &c., London; The Royal Irish Academy, Dublin; The Commissioner of Indian Affairs, Thomas U. Walter, Esq., and M. T. W. Chandler, Esq., Washington, D. C.; Captain Charles Wilkes, U. S. Navy; The Maryland Institute, Baltimore, Maryland; Prof. John F. Frazer, Prof. B. H. Rand, and H. Nolen, Esq., Philadelphia.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Standing Committees for the ensuing year were appointed by the President and approved as follows:

On the Library.

John Allen,
James H. Cresson,
George W. Conarroce,
George Erety,
Samuel B. Finch,
Raper Hoskins,
James Lukens,
Wm. S. Levering,
Clement W. Smith,
Thomas S. Stewart.

*On Cabinet of Minerals
and Geological Specimens.*

Martin H. Boyé,
Isaac H. Conrad,
John F. Frazer,
F. Augustus Genth,
Henry Hartshorne,
John L. Le Conte,
B. Howard Rand,
J. Hamilton Slack,
Laurence Turnbull,
John C. Trautwine.

*On Cabinet of Arts, and
Manufactures.*

James C. Booth,
Thomas Bickerton,
Samuel Broadbent,
Jacob R. Eckfeldt,
John M. Gries,
Edwin Greble,
J. Hall Rohrman,
F. De B. Richards,
James M. Somerville,
John Wallace.

On Cabinet of Models.

William H. Clark,
George W. Colby,
James Dougherty,
George C. Howard,
Henry Howson,
Benjamin Morison,
Clayton B. Rogers,
Charles J. Shain,
William Smith,
Andrew M. Spangler.

On Exhibitions.

John E. Addicks,
John Agnew,
George W. Conarroce,
James H. Cresson,
Owen Evans,
Joseph Harrison, Jr.,
Samuel V. Merrick,
John H. Towne,
Isaac S. Williams,
Thomas J. Weygandt.

On Meetings.

William B. Atkinson,
Henry Howson,
Washington Jones,
J. Vaughan Merrick,
Thomas S. Martin,
John F. Mascher,
John P. Parke,
B. Howard Rand,
Marshal B. Smith,
Laurence Turnbull.

On Meteorology.

Charles M. Cresson,
Owen Evans,
John F. Frazer,
James A. Kirkpatrick,
E. Otis Kendall,

Alfred L. Kennedy,
James A. Meigs,
Edward Parrish,
Theodore Poesche,
Ayres Stockly.

The Treasurer read his statement of the receipts and payments for the month of January.

The Board of Managers and Standing Committees reported their minutes.

Candidates for membership in the Institute (8) were proposed, and the candidates proposed at the last meeting (7) were duly elected.

Dr. Rand exhibited Hoard's gas regulator. This is intended to be attached between the service pipe and the metre, and thus maintain an uniform supply of gas to all the burners in the building. It consists of a small gasometer sealed with mercury, from the top of which a rod passes upwards, and is attached to the apex of a conical valve playing in a conical seat. The gasometer is open within to the atmosphere, and the whole apparatus is enclosed in an iron box furnished with a drip. The gas passing through the box presses upon the top of the gasometer, and as the pressure varies, causes it to rise or fall, carrying with it the valve, and thus maintaining a constant pressure in the metre.

Dr. Rand, also, exhibited a model of an apparatus invented by Aaron Roberts, intended to aid in the extinguishing of fires when in narrow alleys or in high buildings. It consists of a telescopic tube, having at the top a pipe, which is to be guided by chains affixed to it and in the hands of firemen who may be in a secure position. It is on a low carriage on wheels, and may be raised to any required height by means of a rack and pinion. It is intended to be securely stayed by chains fastened to staples in the side of each joint and secured to posts driven in the ground. The water is admitted at its lower end and is supplied from plugs or engines.

Dr. Rand, also, presented a model of a self-acting farm gate, invented by Mr. E. Dunbar. This invention, which it is difficult to describe without the aid of a drawing, has been submitted to the Committee on Science and the Arts.

Mr. F. De B. Richards exhibited a series of beautiful French Photographs. One of these, representing one of the prints of the Louvre, is believed to be the largest picture ever taken, and is remarkable for the sharpness of its outline and the fineness of its tone. It is a collodion picture taken by Bisson Brothers, of Paris, with a plano-convex lens, six inches in diameter, five feet focus, with a diaphragm in front of one inch opening; time of setting, one minute.

Mr. Mascher exhibited a series of stereoscopic pictures bound in a volume and furnished with one of his patent stereoscopes. Any number of pictures with the stereoscope attached may be thus put into a moderate compass, and ready for use at a moment's notice.

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

APRIL, 1856.

CIVIL ENGINEERING.

*On the Railways and Telegraphs of Great Britain.** Address of ROBERT STEPHENSON, Esq., President of the Institution of Civil Engineers, January 8th, 1856.

After a complimentary allusion to the addresses of his predecessors, the President observed, that he would apply himself to the great question of British Railways, which were described as spreading like a network over Great Britain and Ireland, to the extent of 8054 miles completed ;—thus, in length, they exceeded the ten chief rivers of Europe united, and more than enough of single rails were laid to make a belt of iron around the globe.

The cost of these lines had been £286,000,000,—equal to one-third of the amount of the national debt.

The extent of the railway works was remarkable ;—they had penetrated the earth with tunnels to the extent of more than fifty miles ; there were 11 miles of viaduct in the vicinity of the metropolis alone ;—the earth works measured 550,000,000 of cubic yards.

Eighty millions of train miles were run annually on the railways ; 5000 engines and 150,000 vehicles composed the working stock ; and the companies employed 90,400 officers and servants ; whilst the engines consumed annually 2,000,000 tons of coals ; so that in every minute of time 4 tons of coal flashed into steam 20 tons of water. The coal consumed was almost equal to the whole amount exported to foreign countries, and to one-half of the annual consumption of London.

In 1854, 111 millions of passengers were conveyed on railway ; each passenger traveling an average of 12 miles. The old coaches carried an

* From Newton's Lond. Journ., Feb., 1856.

average of 10 passengers; and for the conveyance of 300,000 passengers a day 12 miles each, there would have been required at least 10,000 coaches and 120,000 horses.

The receipts of the railways in 1854, amounted to £20,215,000; and there was no instance on record in which the receipts of a railway had not been of continuous growth, even where portions of its traffic had been abstracted by the competition of new lines.

The wear and tear was great; 20,000 tons of iron required to be replaced annually; and 26 millions of sleepers annually perished; 300,000 trees were annually felled to make good the loss of sleepers; and 300,000 trees could be grown on little less than 5000 acres of forest-land. The President considered, at some length, how these annual depreciations should be met. The principle of a renewal fund was questionable. After a certain period in the history of every railway, deterioration reached an annual average, and as that annual depreciation became a charge, as fixed and certain as the cost of fuel, or the salaries of officers, it should be admitted as an annual charge against receipts.

As regarded fares, the interests of the companies and of the public were identical: companies must regulate fares, by consideration of the circumstances which produced the largest revenue, and the circumstances which produced the largest revenue were those which induced the greatest number of individuals to travel. Nothing was so profitable as passenger traffic, as it cost less, in every way, than goods, and an average train would carry 200 passengers. The cost of running a train was over stated at 15 pence per mile; and 100 passengers at five-eighths of a penny per mile produced 5s. 2½d. But this argument did not imply that, in all cases, fares should be fixed at a minimum. Minimum fares were most profitable on short routes; but the public were too much occupied, to be tempted by minimum fares to undertake long journeys. High rates of speed and increased comforts were then required, and these might be charged for. Every case, therefore, should be treated in consideration of its local circumstances.

The postal facilities afforded by railways were very great. But for their existence, Mr. Rowland Hill's plan never could have been effectually carried out. Railways afforded the means of carrying bulk, which would have been fatal to the old mail coaches. Every Friday night, at present, when the weekly papers were transmitted, 8 or 10 vans were now required for post-office bags on the North Western Railway, and this use of 8 or 10 railway vans implied, at the least, the employment of 14 or 15 mail coaches; and the expenses of 14 or 15 mail coaches to Birmingham, could never have been sustained by a penny postage. For this great blessing, therefore, the nation had to thank the railways. They were the great engines for the diffusion of knowledge. The Parliamentary blue books never would have been printed; for except by canal, or by wagon, they could not have been distributed; and if they could not have been circulated, they would have been useless. Nevertheless, the post-office did not appear to treat railways with all the consideration they were entitled to expect. Great services were required, and in return, it had been contended, that no profit should be allowed to the railway companies, except as carriers and workers of the line.

Railway companies were, therefore, indifferent to postal traffic ; and this was shown to be a serious disadvantage to the public. At present the post-office competed with railways, as carriers of book parcels, a principle which might be extended still further, but not without injustice and hardship to the railways.

Parliamentary legislation for railways was full of incongruities and absurdities, which were graphically described and illustrated. The Acts of Parliament which railways had been forced to obtain, had cost the public fourteen millions sterling. But this was shown to be the exclusive fault of Parliament itself, and of the system it enforced. The legislation of Parliament had made railways pay 70 millions of money to land-owners for land and property ; yet almost every estate traversed by railway had been greatly improved in value. Parliament had taxed the Companies in favor of the land-owners for what was called "severance." Claims for compensation for severance were based on theories which were wholly ideal and imaginary. No one had ever been able to show a practical loss by severance ; and the claim was often made as customary, where it was even admitted that no ground for it existed. The remedy which suggested itself for this state of things, was a competent tribunal, which Parliament was not likely to grant. If a mixed commission could be organized, to consist of practical men of acknowledged legal, commercial, and mechanical ability, there might be some chance of railway business being efficiently conducted. But it was admitted that there was little hope of any such concession.

Railway management was next considered, and shown to be completely anomalous. Parliament had legislated for railways as toll-taking companies ; but every direction was obliged to embark in enterprises foreign to the parliamentary objects of the railway itself. This produced serious dilemmas. As long as dividends were kept up, the Directors were popular, however illegal their acts ; but the moment dividends fell, the Directors, however energetic, wise, or prudent, were visited by the shareholders and the public with all the penalties of having exceeded the letter of the law. Men, whose reputations were at stake, were consequently unwilling to incur the risk of becoming railway directors ; and the most enlightened managers and shareholders were revolving in their own minds how the dilemma could be escaped. It was suggested, that advantage might be taken of the Limited Liability Act, or of some analogous measure, to enable a limited number of men of business to take lines of railway from shareholders on leases, subject to certain conditions and terms. A few of the lessees would then constitute themselves managers ; and being free from apprehensions on account of shareholders, of external interference, or of personal liabilities, they would be able fully to work the line, and enter into those enterprises necessary for its development, and essential to its prosperity. A large profit would accrue to those who took the line, and managed it with vigor and economy ; whilst shareholders would derive great advantages from the certainty of receiving fixed dividends, and from the enhancement of the value of their property ; and practical security would be afforded to the public, whilst their best interests would be consulted.

The Electric Telegraph—that offspring and indispensable companion

of railways—was next considered. 7200 miles of telegraph, or 36,000 miles of wires, at least, were laid down. 3000 people were continually employed, and more than a million of public messages were annually flashed along this “silent highway.” To the working of railways, the telegraph had become essential. The needle was capable of indicating, at every station, whether the line was clear or blocked, or if accident had any where occurred. The telegraph could, therefore, do the work of additional rails, by imparting instantaneous information to the officers, and enabling them to augment the traffic over those portions of the line to which their duty might apply. It also enabled large savings to be effected in rolling stock, by affording the means of supplying such stock to any station at which it was needed, from some other station where it had accumulated and was not wanted. The mode in which this system was worked was described, and its simplicity was commended. As a perpetual current was passing through the wires, the guard, or engine driver, had only to break the train-wire in case of accident, and the officers at the nearest station were instantaneously apprized that something was wrong, and that assistance was needed. Statistics were given, to show that the business of the Electric Telegraph Company had increased fifty-fold in seven years.

Railway accidents occurred to passengers, in the first half of 1854, in the proportion of one accident to every 7,195,343 travelers. Ladies and gentlemen could scarcely “sit at home at ease” with the impunity with which, it appeared, that they could travel by railway. How frequent, comparatively, were the accidents in the street; how fearful the misadventures to those “who go down to the sea in ships.” Yet Parliament had seen fit to legislate expressly for accidents by railways, without legislating in the same way for accidents from other sorts of locomotion. This was unfair to railways, and ill-calculated to afford protection to the public where it was most needed. Lord Campbell’s Act, also, measured men’s lives by a class standard. The family of a high public functionary would get large compensation, whilst the family of the poor working-man would get nothing. The practical tendency of this law was to retard the adoption of low fares. Railway managers were compelled to consider, not only what they might gain, but what they might lose; and the larger the number of passengers, the greater the risk of accident to some one of them. The companies were, practically, obliged to insure the life of every person who traveled on their line, without being able to apportion the premiums to the risks incurred.

The results of railways were astounding: 90,000 men were employed directly, and upwards of 40,000 collaterally;—130,000 men with their wives and families, represented a population of 500,000 souls; so that 1 in 50 of the entire population of the kingdom might be said to be dependent upon railways. To the public “time is money,” and, in point of time, an enormous saving was effected; for on every journey averaging 12 miles in length, an hour was saved to 111 millions of passengers per annum, which was equal to 38,000 years in the life of a man, working eight hours a day; and allowing an average of 3s. per diem for his work; this additional saving was £2,000,000 a year. The moral results of railways were equally remarkable: railways were equalizing the value

of land throughout the kingdom, by bringing distant properties practically nearer to the centre of consumption, and by facilitating the transit of manures; thus enabling poor lands to compete with superior soils. The stimulus afforded to national industry was exemplified, by the progress of the boiler-plate manufacture; and the increased comforts afforded to the people were illustrated by the extraordinary progress of the fish trade, and the development of the inland coal traffic. It was observed, that before railways existed, internal communication was restricted by physical circumstances: the canal traffic was dependent on the supply of water at the summit levels, and upon the vicissitudes of seasons of either drought or frost. Railway communication was free from all these difficulties, and every obstacle that nature had opposed, science had hitherto effectually surmounted.

The address concluded with some words of practical application. The duty devolved on Civil Engineers, of improving and perfecting this vast system. Every farthing saved, on the train mileage of the kingdom, was £80,000 a year gained to Railway Companies. There was, therefore, ample field for economical appliances, and therefore no economical arrangement, however trifling, was to be neglected. Nothing would afford the President greater satisfaction than that from his observations some sound practical improvement should result to a system with which his name, in consequence of his father's works, had been so largely associated; for however extensive his own connexion with railways, all he had known, and all he had himself done, was due to the parent whose memory he cherished and revered.

*Remarks on Floating and Fixed Lighthouses.** By DAVID STEVENSON,
F.R.S.E., M.Inst. C. E.

SIR—At the meetings of the Institution of Civil Engineers held on the 13th and 20th of November, at which I was not present, Mr. George Herbert's proposals for constructing Floating Lighthouses were read and discussed. I find from the Transactions, that on that occasion it was stated that the important objects fulfilled by the Eddystone, the Bell Rock, and the Skerryvore lighthouses, could be attained by means of a floating tower, with equal efficiency, and at a cost greatly inferior to the amount expended on these national works; and in proof of this, the actual cost of these three lighthouses was compared with the *estimated* cost of towers constructed on the new principle. These important sea lights having been thus specially and publicly referred to, I feel that no apology is necessary on my part for taking this mode of vindicating the proceedings of the Boards under whose auspices they were erected, as it can be satisfactorily shown that the objects which they serve could not be obtained in the manner proposed, and, therefore, no comparison of cost, such as has been made in the Transactions of the Institution of Civil Engineers, can in reality be justly or fairly instituted. Mr. Herbert's

*From the Lond. Civ. Eng. and Arch's. Jour., Jan., 1856.

own wish in the matter, as expressed to me, is, that the subject should be fully canvassed.

I do not propose to discuss the important mechanical and nautical question, which is at once suggested by the difficulties to be encountered in maintaining in its site a circular body 80 feet in diameter, and 130 feet in height, moored on the foul and rocky bottom which surrounds the Eddystone, the Skerryvore, or the Bell Rock, amidst the seas to which it would, in any of these situations, be exposed. On this point I shall only say, that in dealing with floating bodies of such size and form, it is possible that even the resources of engineering, which seem to be regarded in the present day as boundless, may be found to have very marked limits prescribed to them, by the formidable and subtle elements of wind and sea, with which, in the case in question, they have to contend. But, in my opinion, such a discussion is altogether unnecessary, because, were the scheme proposed by Mr. Herbert feasible and advisable—which I am not prepared to admit,—it is not difficult to show that, in point of fact, the important objects now fulfilled by the lighthouse towers on these rocks, would not be obtained by means of the proposed floating tower, even if it could be successfully moored and maintained in its position.

It may be regarded as an axiom in lighthouse engineering, that a light exhibited from a *fixed* tower is preferable to one from a *light-ship*, and that a *fixed* beacon or perch is preferable to a *buoy*. No one who knows the subject will deny that a danger can be marked more precisely and advantageously by a sea-mark placed *upon* it, than by a mark moored *off* it; or that a more effective lighting apparatus can be adopted in a *fixed* tower than in a light-ship; or further, that while all lights or sea-marks exhibited from fixed structures may be regarded as *absolutely safe and certain in their exhibition*, all light-ships or buoys are the reverse of this, for their liability to drag their moorings and break adrift is notorious, and the danger to the shipping arising therefrom is very great.

Although, therefore, light-ships and buoys ought never to be adopted where it can be avoided, still, it is at once admitted that there are situations where the difficulty of obtaining a foundation for a fixed structure renders their adoption absolutely necessary; and it cannot be doubted that all endeavors to improve the construction of light-ships and buoys should receive every consideration. This important subject has not escaped notice, for various efforts have been made, from time to time, to improve these sea-marks; and in 1851, Prof. Babbage, in his "Notes on Lighthouses," proposes to light up floating buoys, and in order to procure greater steadiness and safety, suggests that "the buoys should be attached to their moorings by rings fixed at the centre of resistance." But, with every perfection of construction and mooring, the proposition to place a *floating* and a *fixed* light in the same category, and to represent that the one is "as efficient" as the other, cannot be conceded; and this untenable proposition is laid down in the Transactions alluded to, where it is asserted that the sites of the Eddystone, Bell Rock, and Skerryvore might be as "efficiently" marked by the floating-light as by the present lighthouse towers; and the announcement is made that "practical men now seemed to think that the old system should not be con-

tinued, as the sea light-tower is capable of being moored in any depth of water."

In order to show that this proposition cannot be substantiated, I shall, in the first place, remark that a fixed tower such as that erected on the Bell Rock, the Eddystone, or Skerryvore, admits of the adoption of the most perfect apparatus which the engineer, with the combined application of scientific optical research and practical mechanics, can produce; the grand object being to intercept every ray of light, and to project a beam, unvarying in its characteristic appearance, towards the eye of the mariner. But no such advantage can attend the exhibition of a light from a floating tower, as its motion would render impossible the advantageous adoption of the most approved methods of illumination now used in lighthouses.

I may here remark, that from the observations I have made upon one of Mr. Herbert's buoys, which is moored in the Firth of Forth, I have reason to believe that the oscillation of the proposed light-tower will be much more appreciable than he anticipates. Mr. Herbert estimates that the pressure of the wind acting on the tower will cause it to incline $1^{\circ} 28'$ from the perpendicular. This can be determined by experiment only, but if in this estimate the action of the wind is viewed as a statical pressure, without regard being paid to the momentum of the moving tower; and, moreover, if, in addition to this (as I infer from the statement made to be the case), the action of the sea has not been taken into account, I should venture with confidence to predict, notwithstanding the peculiar form of the submerged base of the tower, that the united action of wind and sea, during storms, will produce a *cumulative* effect, and give the tower so great an inclination, as occasionally to take the light altogether out of the view of an observer at the horizon. The destructive result of this will be that, instead of a light with a decided and unvarying characteristic appearance, such as "stationary," or "revolving," or "flashing," being exhibited, we shall have a light altering its character with every heavy gale, when it is of most importance that it should not be mistaken.

In addition to this oscillation, there will undoubtedly be more or less of a rotary or spinning motion of the tower round its axis, which is fatal to the adoption of "revolving" or "flashing" lights in floating towers, and thus in these important situations the advantages of the much greater power of revolving lights, as compared with those which are fixed, could not be secured. To insure the effective working of the delicate machinery connected with the revolving apparatus, and the lamps of a first-class light in a light-room, moving to and fro through a space of 6 feet, as admitted by Mr. Herbert, but which I think is greatly underrated, will be found to afford ample scope for the skill of the optician and mechanic. But, before the adoption of a floating tower can be recognised, some means must be contrived for adapting an *equally perfect* lighting apparatus to the oscillatory and rotary motions of the tower in which it is to be placed—a problem whose solution is, I fear, impossible in lights of the first order. But this difficult problem must undoubtedly be solved before a floating tower is adopted, for it cannot be admitted that any circumstances could justify the use, in such important stations

as the Eddystone, the Bell Rock, or the Skerryvore, or the Bishop Rock (now in progress of construction), of a less perfect means of illumination than that used in the lighthouses erected on the headlands and islands of our coast.

Another obvious objection may be stated, which happens to be very forcibly illustrated in the case of the Bell Rock. No one who is conversant with the circumstances of the case, will venture to affirm that that dangerous reef lying so directly in the track of shipping, whether bound for the Forth or Tay, or passing to and fro along the coast, could be effectually marked by means of anything short of a light erected upon it. Mr. Herbert has not, I suspect, fully considered the important question as to the site in which his proposed tower could, in the situation alluded to, be moored. It must be recollected that the "mooring ground" for a floating light, is analogous to the "foundation" for a light tower. It is in fact the primary inquiry, without a determination of which, based on *careful observation*, it is impossible to offer an opinion as to the practicability of maintaining the moorings, on the stability of which the safety of the structure must depend. The first question therefore, is,—taking into consideration the nature of the bottom and the depth of water around the Bell Rock—at what distance from the rock can a safe mooring be found? The experience obtained during the progress of the works is undoubtedly the best means we possess of approximately solving this question. The floating light used during the building of the Bell Rock was a vessel of 82 tons burden; and, after much consideration, and every care being bestowed on the subject, she was at first moored at the distance of one mile from the rock; but it soon became apparent that she could not ride in safety at that anchorage, and her moorings were ultimately removed to the distance of $2\frac{1}{2}$ miles. It is further worthy of remark, that this vessel, although moored with all care (because on her stability the progress of the works mainly depended) *twice broke adrift and was once run foul of by a vessel* during the four years she was in use. To what greater distance it might be necessary to remove before a proper depth of water and sufficient holding ground for the safe anchorage of such a tower as is proposed could be obtained, is a matter to be settled only by *careful survey*,—but it is obvious that it could not be nearer than the site of the floating light; and it surely needs no argument to prove that a light exhibited at the distance of between two and three miles from a rock, can never be represented as fulfilling "as efficiently" the object of a light-tower erected on the rock itself.

It is probably unnecessary to suggest further difficulties, but other objections may be mentioned as being peculiar to the floating light, and from which the fixed tower is in a great measure, if not altogether, exempt. For example, the result of such a tower breaking adrift by stress of weather, or being driven from its moorings by a vessel striking it, would be the extinction of the light, and the almost certain destruction of the structure itself, and of its inhabitants; whereas with a fixed tower this cannot happen, and even should an ordinary light-vessel part from her moorings, sail can be set, and some chance is held out of working the vessel into a place of safety, which, indeed, has often been accom-

plished. Again, the floating tower cannot remain constantly at its moorings; it must necessarily be removed at intervals for the examination and repair of the bottom, and this in such a situation, for example, as Skerryvore, which is far removed from all mechanical resources, cannot be accomplished without great difficulty and expense. Its temporary removal further involves the necessity of its place being supplied by a duplicate tower and apparatus, for which I do not know that Mr. Herbert's estimates provide. Then the further question is raised, where can this duplicate tower be kept?—where can the permanent tower be placed, so that her bottom may be repaired?—and, above all, what steam-power must be at command, and what risk must be encountered, in towing these towers to and from their sites in such a situation as Skerryvore? But it is unnecessary to enter into greater length as regards these or other objections, as my object is not to point out defects in the proposed *floating* tower, but rather to show that such a structure, even if successfully constructed and safely moored, cannot in any sense be held to be a substitute for the Bell Rock, the Eddystone, or the Skerryvore lighthouses, which, once erected, remain for ever, are more efficient, and are subject to no such uncertainty as attaches to a floating structure.

On what, then, it is natural to inquire, does the recommendation of the proposed iron floating light depend? Not certainly on its greater efficiency, but exclusively on the smaller *estimated* cost of its construction. Nothing is said in the report of the Transactions of the Institution of Engineers on the very important subject of the cost of its future maintenance, which, from the number of men that would be required to take charge of so great a floating structure, the constant tear and wear connected with the moorings, and the expense attending its periodic removal for repair, would obviously be much greater than the cost of maintaining a fixed light-tower. The question of maintenance, however, is not adverted to, and in comparing the estimated *first cost* of the proposed floating light, with the actual cost of the existing lighthouses, Mr. Herbert has somewhat overrated the cost of Skerryvore, and has also, in all probability, overlooked the fact that the amount expended on that lighthouse includes a large expenditure connected with harbor accommodation, together with a signal tower and light-keepers' houses on the neighboring island of Tyree; and that a similar expenditure is included in the cost of the Bell Rock. Now, in any statement in which the expense of these lighthouse towers is to be fairly compared with that of a floating light, it is obvious that these additional expenses should either be deducted or be held as common to any light, whether floating or fixed, which could be established at these places.

Whether Mr. Herbert has adopted this mode of dealing with the estimates, and has included any sum for a duplicate light to be used in the event of the permanent one breaking adrift or being removed for repair, I have no means of knowing; but according to my view of the matter, it is of very little consequence whether he has done so or not, because if by adopting *a more perfect means of illumination exhibited from a more advantageous site, with the absolute certainty of the due exhibition of the light not being interrupted by any casualty, it be admitted that a single ves-*

sel may be saved from shipwreck, then the whole argument founded on the comparison of costs falls to the ground.

Are we, it may be asked, to spend millions of money on the construction of harbors of refuge at Plymouth, Kingstown, Holyhead, Portland, and Dover, for the benefit of our shipping, and to adopt an uncertain and imperfect mode of lighting such terrors to the mariner, as the Eddystone, the Bell Rock, the Skerryvore, or the Bishop, for the sole purpose of effecting a paltry saving of a few thousand pounds? I cannot believe that the importance of such works has been fully estimated by those who can entertain such a proposal.

Many are the vessels that have been lost, and the mariners that have met their graves, in consequence of these dangers. In one remarkable gale at the beginning of this century, seventy vessels were ashore at the same time on the coast of Scotland, the most of which got embayed in their endeavors to avoid the Bell Rock;—at Skerryvore, too, there are authentic records of no fewer than thirty-one vessels having been wrecked upon the rock. Whereas, now that permanent and powerful lights are erected upon these dangerous reefs, vessels steer for them with confidence as beacons of safety, and wrecks upon them are now happily altogether unknown. In these days of enterprise, when such sums are expended by government in harbors of refuge, and even by private companies in works for facilitating our internal communication—such, for example, as the High Level Bridge at Newcastle, or the Britannia bridge across the Menai Straits,—it is impossible to conceive that the country would be satisfied with anything short of the *most perfect* possible means of indicating to the mariner such dangers as these we have been considering, however high the cost of obtaining so important an end might be; nor can I conceive such a case to be a legitimate one for any compromise between *efficiency* and *economy*.

In conclusion, I should not wish to be understood as opposing any obstacle to the improvement of floating lights and buoys: so far from this being the case, a buoy on the construction proposed by Mr. Herbert, and ordered by the Commissioners of Northern Lighthouses at my suggestion, was moored by me in the Firth of Forth, and has now been in use for upwards of two years. I am bound, however, to say that that buoy, although not exposed to very heavy seas or strong currents, does “not retain its perpendicularity,” and does not show better (some are of opinion not so well) as the buoy formerly in use at the same place, which cost 23*l.*, whereas Mr. Herbert’s buoy cost 102*l.* Still, however, I am not prepared to undervalue Mr. Herbert’s investigations, nor to deny that for certain purposes and in certain situations they may be found exceedingly useful; and whenever I shall see an opportunity where they may be advantageously applied, I shall readily adopt them.

My only object in offering these remarks—which have been called for by the reference made to existing lighthouses—is to express my decided opinion, that whenever it can be proved that the erection of a fixed lighthouse on such important rocks as the Eddystone, the Bell Rock, or the Skerryvore, is by *any means practicable*, no question of economy can justify the adoption of what I must style the clumsy expedient of a tower

dependent for its stability on moorings, and containing a light less efficient than the ordinary sealights on the coast, and even this imperfect light situated (it may be) some miles from the danger which it is intended to indicate, and on which the light ought to be placed in order to be useful.

S4 George Street, Edinburgh, Dec. 10, 1855.

*On the Draining of the Haarlem Lake.** By Prof. DOWNING.

The lake of Haarlem, situated in North Holland, contains 44,500 acres, which, previous to its drainage, was covered with a depth of thirteen feet of water, the surface of which was under the mean tide level of the sea; it is now completely dry and under cultivation.

To have an adequate idea of the difficulties encountered in bringing this work to a successful termination, it is necessary to consider the peculiar physical and artificial circumstances of the Netherlands. The greater portion of the surface is at or below the level of the sea, and only protected from being again covered with water by immense dykes, which guard it alike from the rivers and the sea. Along the greater portion of its western boundary, it is, however, in a great degree protected by the *dunes* or sand-hills which form the coast line. The rise of tide along the coasts of the Zuyder Zee is only two feet, and upon the west, in the German Ocean, it is six feet, the mean level being very nearly the same. The annual rain-fall, as deduced from observations continued for nearly one hundred years, is on the average 25.15 inches; the mean annual evaporation is 22.6 inches, distributed, however, very unequally in the winter and summer seasons, thus:

	Summer.		Winter.		Total.
Fall of rain,	10.5 in.	.	14.65 in.	.	25.15 in.
Evaporation,	15.9 "	.	6.7 "	.	22.6 "
	<u>-5.4 in.</u>	.	<u>+7.95 in.</u>		<u>=2.55 in.</u>

As to the artificial features of Holland, we find that from the very earliest times it has been divided into districts of greater or less extent, placed under the control of a governing body (*Waterschappen*), which we may call the Hydraulic Administration; the boundaries of these administrations (which are not conterminous with those of the provinces, or any fiscal or municipal districts) are formed by large and lofty dykes, in which are placed self-acting sluices for the discharge of the waters within the boundary dyke, and closing against the admission of any of the external waters. Lake Haarlem is situated in the administration of Rynland, which has discharging sluices into the German Ocean at Katwyck, into the Zuyder Zee at Sparndam and Halfwege, and into the river Yssel at Gouda.

Within every Hydraulic Administration are three divisions of surface, called the Natural Lands, the Basin, and the Polders. The basin is the total area of water surface within the boundary dyke; the natural lands

* Proceedings of the Royal Irish Academy, 1854-5.

are a little above the level of the basin, and discharge the rain-fall off their surface naturally; the polders are lands below the level of the basin, at various depths, from a few inches to twenty feet, and from which, consequently, the water must be raised mechanically, by wind-mills generally, and latterly by steam-power. The Ryndland contains—

Basin,	.	.	.	56,000	acres.
Natural lands,	.	.	.	76,060	"
Polders,	.	.	.	173,000	"
					305,000 acres.

Lake Haarlem, which had been part of the basin, is now added to the polders, so that, instead of 56,000 and 173,000 acres, we now have 11,500 acres of basin, and 217,500 acres of polders, in this Administration. Regarding, then, the basin in its most important duty, that, namely, of a receptacle of the rain-fall when the self-acting sluices may happen to be closed against the external waters, we see how greatly its powers of storage are now reduced. To obviate this disadvantage it was necessary to put up engines of 200 and 100 horse-power at Sparndam and Halfwege, and widen the channel leading to the Katwyck sluice. Another work preliminary to the drainage was the navigable canal (*Ringvaart*), adapted to vessels drawing 8 feet of water, which previously traversed the lake; this canal had a total length of 36 miles, and width of 146 feet, the inner bank being in fact the dyke surrounding the lake, and cutting off the waters which otherwise would flow in during and after the laying dry of the bed.

All preliminary works being thus completed, the raising of the waters up to the level of the sea was effected by three engines of 350 horse-power each, on the Cornish principle, constructed by Harvey & Co., at Hayle foundry, after designs by Messrs. Gibbs and Deane; the cylinders were 12 feet diameter and 10 feet stroke. From numerous and unforeseen causes of delay they were thirty-nine months in raising the water; and instead of 800,000,000 of tons of water, the computed contents of the lake, they actually raised 1100,000,000 tons. These engines will be required for all time to keep dry the land they may be said to have created, not, however, by that continuous working by which the first operation has been performed, but by throwing off extraordinary rain-falls before they have injuriously affected the land. Eight inches of rain-fall and infiltration per month is the maximum quantity that long continued observations lead them to expect, and this can be raised in about twenty-five working days by the 1150 horse-power of the three engines.

The original estimated cost of all the works of the drainage was £687,500; the actual expenditure, £827,200. The sale of the land has realized about £400,000, and the land tax, 7s. 4d. per acre, being capitalized, would yield a like sum; nor must we omit the saving of £5000 per annum, formerly expended in guarding the banks of the lake from destruction during storms, but which now of course ceases.

AMERICAN PATENTS.

List of American Patents which issued from February 19th, to March 11th, 1856, (inclusive,) with Exemplifications.

FEBRUARY 19.

93. For *Improvements in Machines for Sowing Seed Broad-cast*; Edward H. Berry, Hudson, New Hampshire.

Claim.—"The perforated sowing cylinder, and the secondary internal perforated distributing cylinder, connected with the hopper at its centre by the tubes, with its central portion or tube enlarged, so as to distribute the seed evenly to the whole length of the lower portion of the sowing cylinder, in order that the seed may be cast or sown evenly broad-cast over the soil."

94. For an *Improvement in Forks*; Sherburne C. Blodgett, Philadelphia, Pa.

Claim.—"The construction of forks, with a metallic web or sheets between a part of the prongs."

95. For an *Improved Fountain Pen*; Henry A. Brown and James Wiley, Brooklyn, New York.

Claim.—"Making the pen with a solid half-circular head, and arranging it to slide in the pen holder, (having a face-plate, as set forth,) so as to operate as a slide valve or cut-off to the flow of ink."

96. For an *Improvement in Machines for Sawing Marble*; Wallis Bull and George Bull, Tonawanda, Pa.

Claim.—"Securing the saws in the frame by means of the boxes, provided with rollers and rods, having on their inner ends swivel boxes, to which the ends of the saws are attached, whereby the saws may be properly strained in the saw frame, and at the same time allowed to move laterally therein."

97. For an *Improvement in Cooking Stoves*; Abner Burnham, Albany, New York.

Claim.—"The combination of an air chamber surrounding the fire chamber having inlets for the admission of air from without, with an air flue lying between the top of the fire chamber, with its flue and the top plate of the stove, together with an outlet from the same by a pipe or radiator placed within the smoke pipe or flues."

98. For an *Improvement in Rolling Metal*; G. H. Corliss and E. Harris, Providence, Rhode Island.

Claim.—"1st, The combination of the reciprocating roller carriage, with the guides and a table. 2d, Raising the roller for the purpose of placing the work between it and the table, by fitting the roller carriage to the oblique slots in the sliding boxes, providing latches to secure the carriage in the sliding boxes during the rolling operation, but to loosen them and allow them to run up the slots at the termination of the return movement of the roller. 3d, The arrangement of the crank shaft relatively to the rolling table and roller carriage."

99. For an *Improvement in Forging Thimbles*; G. H. Corliss and E. Harris, Providence, Rhode Island.

Claim.—"1st, The employment of forging thimbles, of an anvil and hammers. 2d, In combination with the arrangement of the shafts, of the eccentrics out of the stocks which carry the hammers or squeezers, we claim the inclined guides to receive the said stocks, after the withdrawal of the eccentrics, and the levers for the movement of the stocks up the said guides to withdraw the hammers or squeezers from the interior of the thimble to admit of its removal from the machine."

100. For an *Improvement in Vault Covers*; John B. Cornell, City of New York.

Claim.—"The flat faced panes of glass secured in positions that bring their exposed surfaces flush, (or a little above) the upper faces of the bars of the metallic frame, when said bars have grooves between said upper faces which form gutters around the panes of glass."

101. For an *Improved Grapple for Raising Stone*; Marcus M. Cass and L. R. Bigelow, Watkins, New York.

Claim.—"The combination of the levers, braces, and wedge, for the purpose of making a grapple for raising stone or other heavy bodies, when the power to raise such bodies is applied to the wedge, and through it to the levers to cause their jaws to tightly grasp and hold the body to be raised."

102. For an *Improvement in Sewing Guides*; Seth P. Chapin, City of New York.

Claim.—"The method of forming hems on the edge of flexible materials by means of folding guides made to turn the edge 180° or more. Also, the employment of a spring or analogous device; 1st, To hold and guide a piece of cloth by an edge or plait. 2d, To cause the cloth to follow the guides placed between it and the needle with certainty. 3d, To keep the cloth on a stretch while the stitch is being drawn."

103. For an *Improvement in Seeding Machines*; Stephen Gorsuch, Altoona, Pa.

Claim.—"Placing the screws in the conveying tube or spout, the front or back sides of the tube or spout being open."

104. For an *Improvement in Power Looms*; John Johnson, Troy, New York.

Claim.—"Inserting the wires at the same instant the shuttle is thrown, by which I save a pick by the employment therefor of a double shed. Also, the vibrating belt or its equivalent to which the wires are connected, arranged, and combined."

105. For a *Flexible Pen-holder*; Francis J. Klein, City of New York.

Claim.—"A pen-holder constructed in two distinct and separate pieces or sections, so that the lower section shall be a lever having the metallic rivet as a fulcrum. Also, the peculiar formation of the chamber in section, and of the arm of the lever, by means of which formation and adaptedness each to the other, the holder is rendered more symmetrical, compact, and a movement of the aforesaid lever is permitted only in one direction, and for a limited distance, and a motion in any other direction is absolutely prevented."

106. For an *Improvement in the Mole of Draining Ploughs*; A. E. & C. Marquiss, Monticello, and Charles Emerson, Decatur, Illinois.

Claim.—"The peculiar shape of the mole, which enables its forward movement to form a subterranean perforation whose top and sides will be smoothly and densely compressed, and whose bottom will be left almost entirely uncompressed. Also, giving the tail of the mole such a shape and position that it will serve to close up the slit cut by the mole shank in forming the perforation, and also serve to lead the mole upwards to the surface of the ground as soon as the beam is allowed to turn on its axis."

107. For an *Improvement in Ploughs*; James B. Mell, Riceboro', Georgia.

Claim.—"The standard with braces in combination with braces and beam constructed in the manner set forth."

108. For a *Machine for Tenoning Window Blinds*; John H. Palmer, Elmyra, N. Y.

Claim.—"Operating the disks to which the cutters are attached by means of the cams arranged as shown."

109. For an *Improvement in Billiard Table Cushions*; Michael Phelan, City of New York.

Claim.—"A billiard table cushion composed of a block of india rubber, a layer of cork, and a strip of leather."

110. For an *Improved Mode of Applying Shafts to Axles*; Charles S. Pitman, Swampscot, Massachusetts.

Claim.—"The manner in which I have applied such to a shaft and axle, the same consisting in extending the india rubber bolt protector each way beyond the holding strap, in combination with extending it entirely around the bolt, whereby under any upward or downward movement of the shaft, not only the bolt but the connexion fork will be protected from wear and liability to make a noise, while under sudden starting or stopping off the draft animal connected to the shaft, and the strain on the bolt and fork will be eased by the spring or elasticity of the bolt protector."

111. For an *Improvement in Temples for Looms*; Rensselaer Reynolds, Stockport, New York.

Claim.—"The arrangement and gear of the shank of the opening and closing jaw with the stop or roller, in combination with the closing and receding spring, for the operation together."

112. For an *Improvement in the Construction of Pessaries*; F. Roesler, City of New York.

Claim.—"An instrument composed of a ring and two supporting pieces hinged thereto by spring stop-hinges, either with or without a front or back supporting piece. Also, fitting the supporting pieces to their hinge with a pin and socket, or the equivalent thereof, to allow of one or both of the supporting pieces being set obliquely to the ring or extended lengthwise."

113. For an *Improvement in Hubs for Carriages*; Joseph Smith, Sunbury, Delaware County, Ohio.

Claim.—"The combination with the axle of vehicles of a segmental box, slotted cylinder, and friction rollers."

114. For a *Machine for Printing from Engraved Plates*; James F. Starrett, City of New York.

Claim.—"1st, One or more traveling platforms attached to revolving arms and carrying engraved plates from inking to wiping, and then to printing apparatus, in succession, or to any two such—such apparatus being so arranged that the last and first of the series are next in succession, and the arms revolve in the same direction continuously. 2d, Causing engraved plates, which are carried around in the circumference of a circle, to be submitted to a printing cylinder in a line parallel to its own axis, and not in radial lines of the circle in which the plates are carried, and then permitting them to pass in contact with said cylinder in lines perpendicular thereto, and not in the arc of a circle. 3d, Imparting to a plate or plates thus handed, a zig-zag or devious progressive motion, while they are passing in contact with certain cloths or rollers. 4th, The flexible connexion between the plates or their beds, and the handing or carrying arms, as also, grooved tracks, or their equivalents, acting upon beds so attached, and also these two in combination. 5th, Such flexible connexion in combination with a stop, whereby an engraved plate carried upon a revolving arm is properly presented to the action of the impression cylinder. 6th, Wet wiping an engraved plate by means of a traveling cloth acting in combination with a plate having a zig-zag progressive motion. 7th, An automatic oscillating receiving table in connexion with the printing apparatus, wherein are printed in succession, sheets having different matter printed thereon, so that similar sheets may be laid in the same pile. 8th, Vibrating chaps or fingers in combination with the tapes for completing the delivery of a printed sheet and depositing it upon a table."

115. For *Improvements in Machines for Sawing Marble in Obelisk Form*; P. Schrag and Wilderich J. Von Kammerhueber, Washington City, District of Columbia.

Claim.—"1st, The use of belts or their equivalents, adjustable in their length, in combination with the saw frames, in which the saws are strained independently of said belts, whose adjustability is solely for the purpose of permitting change in the distance or in the angle of the saws. 2d, The saw supporters adjustable both horizontally and vertically, whereby we are enabled when cutting parallel or inclined grooves, to place the saws in the same plane, that they may commence and end their work simultaneously; and also, when it is desired to cut crosswise or to a point, to place the saws in different planes the one above the other. 3d, The adjustability of the roller upon the shaft of the straining apparatus, which permits the retention of the belts in a horizontal plane, whether the saws and their frames are placed in the same or in different horizontal planes."

116. For an *Improvement in Machines for Preparing Vegetables for Preservation*; Masa B. Southwick, St. Hilaire, Canada East; dated February 19th, 1856; patented in England September 15th, 1853.

Claim.—"The improved mode of separating the skins or peels of potatoes and other vegetables from the pulp and skins together, against the denticulated or serrated edge or edges of pieces of metal or other material, whether such pieces be aqueline-shaped or otherwise, provided the skins are caught by the teeth and are thereby separated and taken from the pulp, whether the teeth be shaped like saw teeth or otherwise, or whether

the working table be of circular form and revolving, or be made of any other shape, and caused to vibrate and move from side to side to produce the effect of the circular trough or table."

117. For an *Improvement in Furnaces for Heating Slugs for the use of Hatters, Tailors and others*; Russel Wildeman, Charlestown, Massachusetts.

Claim.—"The plate in combination with the fire box and lifting arrangement."

118. For an *Improved Stave Machine*; George W. Livermore, Assignor to Livermore Manufacturing Company, Cambridgeport, Massachusetts.

Claim.—"The machine for jointing, crozing and chamfering staves, consisting essentially of the clamp for holding the stave, the jointers, and the crozing, chamfering cutters."

119. For *Photographic Pictures on Japanned Surfaces*; Hamilton L. Smith, Gambier, Assignor to William and Peter Neff, Jr., Cincinnati, Ohio.

Claim.—"The obtaining positive impressions upon a japanned surface, previously prepared upon an iron or other metallic or mineral sheet or plate, by means of collodion and a solution of a salt of silver and a camera."

FEBRUARY 26.

120. For an *Improved Machine for Depositing Coal in Cellars*; William Bell, Boston, Massachusetts.

Claim.—"The bed-plate, conductor, and slide, with the tube attachments, in connexion with a hole in the cart, or other vehicle."

121. For an *Improved Pitman*; Andrew Blaikie and Walter Clark, St. Clair, Mich.

Claim.—"The exclusive application of the hollow rod or tube, and the combination therewith of the wood, bushes, and straps, gibs, keys and bolts."

122. For an *Improved Machine for Edging Wall Paper*; H. J. Brunner, Nazareth, Pennsylvania.

Claim.—"The bearing parts, supporting arms, movable blocks, sliding carriage, and adjusting device. Also, the sliding clamps. Also, the combined arrangement of the rolling and unrolling devices, so that they may be quickly shifted from one side of the machine to the other."

123. For an *Improvement in Wagons*; Benjamin B. Bundy, Walton, New York.

Claim.—"The mode of combining springs or axles of wagons."

124. For an *Improved Mill Saw*; Nathan T. Coffin, Knightstown, Indiana.

Claim.—"The arrangement of the common shaped mill-saw teeth on the blade, in sets of three teeth each, with a wide deep space under the lower tooth of each set of teeth. Also, the increasing of the space of the teeth from the centre of the saw each way to the ends. Also, the regular combination of the square edged to the diamond or bevel-pointed teeth, the former standing straight with the blade."

125. For a *Combined Knife and Pencil Case*; Richard Cross, Attleboro', Mass.

Claim.—"My improved mode of constructing such a handle, viz: of two separate tubes, so formed and applied, that when one is extended through the other, it shall not only serve to support it on two of its opposite sides, so as to prevent them from being crushed inwards, but form with the remainder of the enclosing tube, and between it and the latter, one or more chambers, for the reception of instruments. Also, arranging the spring of the knife blade in a slot, made through the shank of the blade."

126. For a *Dove-Tailing Machine*; Ari and Asahel Davis, Lowell, Mass.

Claim.—"The arrangement and operation of the cutters, one movable and adjustable with the bar which carries it, and the other stationary, so as to bevel and form the groove in one end of the wood, and bevel and form the tongue to fit the groove on the opposite end of the wood, at one single operation, so as to complete the dove-tailing of each piece of any desired length without changing the cutters. Also, the carriage, or its mechanical equivalent, and its movable and adjustable slide, which carries the board being dove-tailed, and which can be moved and adjusted, in conjunction with the bar or way, and cutters thereon, so as to give any desired length to the board."

127. For an *Improvement in Machinery for Making Shirt Collars*; Othniel W. Edson, Troy, New York.

Claim.—"The jaws, tongues, and blades, to simultaneously fold inward two contiguous edges of double cloth. Also, giving a forward longitudinal motion to the blades immediately after the edges of the cloth have been turned inward, thereby to complete the formation of the corners of articles folded."

128. For an *Improvement in Churns*; John W. Fiester, Winchester, Ohio.

Claim.—"The cams and eccentric circle, in combination with the agitators, for the purpose of breaking or cutting the current of cream in its passage through them, and for producing friction, by the lateral motion of the two sides of the agitator."

129. For an *Improved Box for Carriage Hubs*; A. C. Garratt, Roxbury, Mass.

Claim.—"The combination and arrangement of this peculiar lubricator, with the recess groove or oil chamber of the box, so as to form an improved combination wheel box for carriage axles."

130. For an *Improved Coupling for the Joints of Felloes*; S. A. Garrison and D. C. Morey, Chelsea, Massachusetts.

Claim.—"The stay bolt, composed of head, stay, and bolt, in combination with the embracing cap piece, tightened, for securing the joints of felloes from lateral movement, in addition to security against radial action."

131. For an *Improved Air-cock for Steam Heating Apparatus*; Stephen J. Gold, New Haven, Connecticut.

Claim.—"The automatic regulation of the air-cock, by a secondary action of a fluid which vaporizes at a low temperature."

132. For an *Improvement in Girders for Bridges*; Peter C. Guiou, Cincinnati, O.

Claim.—"The application of segmental timbers on the top of the iron arch. Also, the peculiar combination of parts, constituting the arch, to wit: the two angle irons, the spurs or double screw-backs, and the timbers."

133. For an *Improvement in Arched Trussed Bridges*; Horace L. Harvey, Quincy, Illinois.

Claim.—"The use of compression braces, in combination with the tension braces, to support alternate bearing points. 2d, The clamps, with or without slots in them, or slots in the arch, with or without friction rollers transversing the wedge blocks, in combination with the truss, for the purpose of allowing the truss to rise and fall, in proportion to the change in the chamber of the arch."

134. For an *Improvement in Projectiles*; Charles T. James, Providence, R. I.

Claim.—"1st, The combination of a band of fibrous packing around a cannon ball, with a means of distending it into the screws or rifles of the cannon, (without enlarging the shot itself, as is done, when it is wholly or partially formed of flexible metal,) by the pressure of the explosive gas. 2d, The combination of a mandrel passing through the shot, for the purpose of driving out the pins, with a nut for drawing it in. 3d, The combination of a mandrel entering the shot with a ratchet, or equivalent catch, for holding it in its place. 4th, The combination of any pliable packing ring surrounding the shot with the openings communicating between its inner surface and the chamber where the explosive gas is generated, for the purpose of communicating the power to distend such packing."

135. For an *Improved Machine for Separating Gold and other Precious Metals from Foreign Substances*; Edward N. Kent, City of New York.

Claim.—"The employment of what I term a grain separator, for separating the grains of metal from the earthy substances or crushed gangue, preparatory to, and in combination with the crusher, or equivalent therefor, when the separator is employed as a hopper to the crusher, and combined therewith by a feeding tube, or equivalent therefor, for conducting the substances to be crushed, below the surface of the column of water in the crusher. Also, an improved Chilian mill, consisting of a deep water vessel, holding a high column of water, in which the double acting vertical wheels combined therewith, are wholly, or nearly submerged."

136. For an *Improvement in Laups*; W. M. Kimball, Rochester, New York.

Claim.—"The recess."

137. For an *Improvement in Domestic Steam Generators*; James T. King, City of New York.

Claim.—"The combination of a water tank, steam chamber, and steam generator, connected together, so that the height of the water in the water tank above the orifice of the pipe leading to the steam chamber, shall always regulate the pressure of the steam. While there will be a free escape of steam as soon as the water in the water tank falls below said orifice."

138. For an *Improvement in Percussion Locks for Fire Arms*; J. H. B. Latrobe, Howard County, Maryland.

Claim.—"1st, The hammer, chambered to receive the primer, in combination with a pusher attached to the lock plate, and protruding the primer as the hammer moves. 2d, The movable cutter, in combination with the projection on the piece, to cut off the cap to be exploded, while at the same time it closes the chamber and protects the rest of the primer from the fire of the explosion. 3d, The claw on the end of the detent, to keep the primer always in place for protrusion. 4th, The movable catch for throwing the pusher out of play. 5th, The ferrule round the boss, in combination with the chambered hammer. 6th, The twisting of the primer between the boss and pusher, to permit of its being bent to suit the form of the hammer. 7th, The arrangement of the parts above described, so as to protrude the primer, while the hammer is falling, instead of while the piece is being cocked."

139. For a *Process of Painting or Varnishing Woven Wire*; William Lincoln, Oakham, Massachusetts.

Claim.—"Exposing the wire-work cover or article, after having been dipped in the varnish, to a powerful blast or current of air, so brought to bear upon it as to pass through and clear its meshes of the liquid varnish, and pile it more on one side of each side of the wires, than on the opposite side thereof."

140. For an *Improvement in Horse Rakes*; Nathan Martz, Briar Creek Township, Pa.

Claim.—"The combination of the coiled spring, axle, rock shaft, and rake teeth."

141. For an *Improvement in Binding Guides*; James S. McCurdy, City of N. York.

Claim.—"The centre piece, in combination with the plates, for the purpose of adjusting the binder, for the use of binding of different widths, and of applying the same with unequal lap to the material bound."

142. For an *Improved Mode of Constructing Walls and Floors of Cellars*; A. R. Moen, City of New York.

Claim.—"The mode of forming walls and floors, by combining into one mass the cement and asphaltum, by means of the stone or other suitable material, by which the asphaltum is caused perfectly to adhere to the bricks or stone of the work, and admit the hydraulic cement; also, to adhere to the same stone or brick."

143. For an *Improvement in Sewing Machines*; T. J. W. Robertson, City of N. Y.

Claim.—"The looper."

144. For an *Improved Apparatus for Heating by Gas*; W. F. Shaw, Boston, Mass.

Claim.—"The combination and arrangement of air and gas burners, or distributors, chambers, and their flues and air supply conductors. Also, in combination with the gas burner, the open top and closed bottom wire gauze tube."

145. For *Improved Door Spring*; D. G. Smith, Carbondale, Pennsylvania.

Claim.—"The use of the lever, in connexion with the barrel and spring."

146. For a *Boring Machine*; James Temple, Birmingham, Pennsylvania.

Claim.—"The combination of the horizontal and vertical slides."

147. For an *Improvement in Velocimeters for Vessels*; Ira F. Thompson, Westerly, Rhode Island.

Claim.—"The gate or slide actuated by the vertical weighted lever or pendulum, in combination with the hinged drag."

148. For an *Improvement in Instruments for Measuring the Lengths of Braces in Carpentry*; Herman Whipple, South Shaftsbury, Vermont.

Claim.—"The button, to receive and clamp the square on the centre line of motion of said button. Also, the traveler, with one side on the line of the slot and centre of the button."

149. For an *Improvement in Machinery for Hardening Hats*; R. Wildman, Charlestown, Massachusetts.

Claim.—"The inflated elastic rubbers."

150. For an *Improved Method of Excluding Dust from Railroad Cars*; Joseph Wood, Jersey City, New Jersey.

Claim.—"The employment or use of the slotted frame attached to the sides of the bottom or platform of the car."

151. For an *Improvement in Bending Sheet Metal*; J. Wright, Harmar, Ohio.

Claim.—"The combination and arrangement of the setting down, bending, and finishing rollers or wheels, with the disk, for operation together, and in relation thereto and each other, the one wheel having a projecting ledge or head, for the purpose of gauging the double seam, 'and clipping or holding it from opening' whilst being bent."

152. For an *Improvement in Cultivating Ploughs*; William C. Wyche, Brookville, North Carolina.

Claim.—"A series of knives or cutting blades on the standard, in the place of, and for dividing, cutting, and turning the furrow slice horizontally or nearly so, and depositing the pulverized soil mostly in the furrow, and turning the sod or turf upon the surface."

153. For an *Improvement in Coffee Pots*; Jacob M. Webb, Sommerville, Tenn.

Claim.—"The tubes and the fall."

154. For an *Improved Wheelwright Machine*; Chauncey H. Guard, Assignor to self and J. A. Scroggs, Brownsville, New York.

Claim.—"The combination of the boring and mortising shafts with the levers, through the medium of the toothed saddles, the toothed segments, and the oscillating shafts."

155. For an *Improved Arrangement of Means for Operating the Valves of Steam Engines*; John Scheitlin, Assignor to self and Oliver Dailey, Washington, D. C.

Claim.—"The four teeth cylinder, keyed on the main driving or crank shaft, the Maltese cross with the shaft and the small crank keyed thereto, said cross by means of the feather, being susceptible of a free and steady to and fro motion along, whilst driving its shaft, not being so moved by the rock and pinion, a screw, and by which, also, it can be retained on its shaft in any desirable position in relation to the cylinder, whereby a single steam valve of a steam engine can be worked, either as a feed valve, or as a feed and as a cut-off valve alternately, and the steam cut off at any required point of the stroke whilst the engine is in operation."

156. For an *Improved Sawing Machine*; William J. Wood, Assignor to self and John S. Gallaher, Jr., Washington, D. C.

Claim.—"Attaching the saws to the opposite ends of two parallel rocking beams, by means of swivel bearings, and in combination with the mode of straining. Also, in combination with the table and upright or column, the reversible graduated scale gauge."

ADDITIONAL IMPROVEMENTS.

1. For an *Improvement in Hydraulic Heaters*; Lewis W. Leeds, and R. M. Smith, Philadelphia, Pa.; original patent dated May 16, 1854; additional Feb. 5, 1856.

Claim.—"The use of the radial ribs, in combination with tubes, irrespective of form of said tubes."

2. For an *Improvement in the Manufacture of Ornamental Felt Cloth*; O. B. Tomlinson, Athens, Pa.; original patent dated June 5, 1855; additional Feb. 5, 1856.

Claim.—"The manufacturing of ornamental felt fabrics, by placing loose woven or knit felting or shrinking fabrics of any color or design upon the surface of the sheet of batting, composed of any felting or shrinking substance, and shrinking the same orna-

menting fabric or fabrics into the body of the felt, to form an ornamental felt fabric of the character and quality described."

3. For an *Improvement in Candle-sticks*; Abner Whitely, Springfield, Ohio; original patent dated January 8, 1856; additional Feb. 5, 1856.

Claim.—"1st, Securing the lip to the stem, and within the slide, as described, whereby I am enabled to use a solid lip and avoid all leakage. 2d, The open slide as described, for avoiding damage."

4. For an *Improvement in Daguerreotype Cases*; John F. Mascher, Philadelphia, Pa.; original patent dated March 8, 1853; additional Feb. 19, 1856.

Claim.—"The combination and arrangement of a series of levers of any suitable material, containing photographic or other pictorial representations, (interspersed or not with blank or printed leaves) with supplementary lid or adjustable flap, containing a lens or lenses as described, the same being united or bound together so as to form a book."

5. For an *Improvement in Grinding Mills*; Amory Felton, Troy, N. Y.; original patent dated Jan. 2, 1855; re-issue Jan. 29, 1856; additional Feb. 26, 1856.

Claim.—"Combination with the cylinder, concave, and spiral ribs, the cracking or crushing apparatus preceding the grinding surfaces, for the purpose of adapting the mill to the grinding of corn, and the cobs, or other similar material."

RE-ISSUES FOR FEBRUARY, 1856.

1. For an *Improved Tonguing and Grooving Machine*; Charles W. Brown, Boston, Massachusetts; patented August 14, 1844; re-issued February 5, 1856.

Claim.—"1st, Giving a lateral movement to either of the edge cutters, by any suitable arrangement of mechanical devices, while the board is being fed through the machine so as to adapt the edge cutter to any taper of the board. 2d, Arranging the box or bearing of the shaft of either of the edge cutters, so as to slide laterally on a rail, and connecting said box or bearing to a sliding guide bar, which bar is governed or regulated in its movements by the edge of the board, and kept up against said edge by means of a weight operating on it (so as to press it laterally), through the medium of a rack and pinion. 3d, The combination of the sliding bolts with the turning rod, (having right angular arms,) and pawl and ratchet wheel on the end of the shaft which the weight turns or revolves, for the purpose of permitting or checking the operation of said weight upon the sliding guide bar."

2. For an *Improvement in Polishing Stone, Metals, &c.*; A. Broughton, Malone, New York; patented November 7, 1854; re-issued February 12, 1856.

Claim.—"A process by which the friction of the surface of the rotating polishing wheel upon the surfaces of the articles operated upon, will impart rotary movements to said articles."

3. For an *Improvement in Spike Machines*; Ammi M. George, Nashua, N. H.; patented December 18, 1855; re-issued February 12, 1856.

Claim.—"The friction roller and lever, to which the cutter is attached, when said roller and lever are placed upon adjustable centres, or pivots, or rods, in combination with pointing dies inserted in the jaws."

4. For an *Improvement in Machines for Sewing and Stitching Straight Seams*; Isaac M. Singer and Edward Clark, Assignees of J. J. Greenough, City of New York; patented February 25, 1842; re-issued February 12, 1856.

Claim.—"1st, The feeding of the article to be stitched automatically forward to the needles so as to determine thereby the length of the stitch by means of the apparatus. 2d, The employment of a weight, or its equivalent, to draw out the thread. 3d, The combination of pincers to draw the needles and thread through the article being sewed. 4th, For the purpose of working with two needles at the same time. I claim giving to the pincers a simultaneous lateral movement, to change the needle from one pair of pincers to the other. 5th, The stop motion consisting of an arrangement of apparatus described, for stopping the machine when the thread breaks or becomes too short."

5. For an *Improved Ticket Register for Railroad Cars, &c.*; William Apperly, City of New York; patented May 1, 1855; re-issued February 19, 1856.

Claim.—"Providing a suitable box for holding the tickets, and employing and ar-

ranging a distributing lipped slide upon the bottom of said box, or underneath the tickets, in combination with the employment and arrangement on top of the tickets of a spring or weighted follower. Also, providing the extension or small box inclined way."

6. For an *Improvement in Harvesting Machines*; John H. Manny, Rockford, Illinois, Assignor to P. H. Watson, Washington, D. C.; patented October 17, 1854; ante-dated June 15, 1854; re-issued February 19, 1856.

Claim.—"A draft bar or tongue, constructed with an arm extending backward over the main frame, and connecting it with a suitable device for supporting it at various heights, whereby the cutter can be conveniently adjusted to different heights, by an attendant on the main frame."

7. For an *Improvement in Sewing Machines*; W. H. Johnson, Greenville, Mass.; patented March 7, 1854; re-issued Feb. 26, 1856.

Claim.—"1st, Making of a seam with a single thread, by the combination of a single needle, forked hook, and expanding lever. 2d, The forming or making of a seam from a single thread, by the running of the loop of the thread through the material to be sewn, the running of a second loop through the material, and putting the first loop through the second, the running of a third loop through the material, and through the first named loop, the carrying of a fourth loop through the material, and putting the third through it, and so on, putting the first loop through the second and around the third, the third loop through the fourth and around the fifth, and so on, forming the belaying double loop stitch. 3d, The feeding of the material to be sewn by means of a vibrating piercing instrument, whether said instrument be the needle itself, or an independent instrument in the immediate vicinity thereof."

8. For an *Improvement in Spark and Gas Consumers*; David Matthew, Philadelphia, Pa.; patented Feb. 20, 1849; re-issued Oct. 4, 1853; re-issue Feb. 26, 1856.

Claim.—"The combination of the receiving case, shield-plate, or head and filterer, with and over the top of the sectional chimney, with enlarged base and smaller section in the smoke box, to convey off and arrest the sparks without pernicious effect. Also, increasing the base of the chimney beyond the diameter of the upper end of the section, extending vertically to near the lower horizontal flues and bottom of the smoke box, to aid in the generation of steam. Also, the trumpet-mouthed tube over the chimney, said tube being divided into two or more parts, to collect sparks and direct them inwardly by aid of the opening between said parts. Also, the manner in which I connect the case at the top of the chimney with the furnace or fire box, by means of the tubes or pipes, the cases, and the openings thence into the fire box or furnace, to carry the sparks and gas to the furnace to be consumed."

DESIGNS FOR FEBRUARY, 1856.

1. For *Gates*; H. E. Wesche, Assignor to Robert Wood, Philadelphia, Penn.; dated February 5, 1856.

Claim.—"A gate for cemetery enclosures as represented on the drawing."

2. For *Printing Type*; Lawrence Johnson, Philadelphia, Pa.; dated Feb. 12, 1856.

Claim.—"The forming on the face of the printing type such figures that the letters printed therefrom shall represent in the upper portion of each letter a colored ground, with white stars, and in the lower portion, alternate white and colored stripes."

3. For *Moulded Bricks*; James M. Thompson, Philadelphia, Pa.; dated Feb. 12, 1856.

Claim.—"The shape of the brick and the ornaments that are on the brick."

4. For *Gates*; H. E. Wesche, Assignor to Robert Wood, Philadelphia, Penn.; dated February 12, 1856.

Claim.—"The design for a gate, as represented."

5. For *Bottle Castors and Egg Cup Stands*; R. Gleason, Jr., Assignor to R. Gleason, & Sons, Dorchester, Mass.; patented Feb. 12, 1856.

Claim.—"The ornaments upon the sides of the case, the scrolls on the upper and lower edges of the sockets, the ornaments upon the outer sides of the sockets, the headed rims and scrolls on the plates, and the figure and levers which form the main portion of the handle."

6. For *Cooking Stoves*; S. Pierce, Troy, and James J. Dulley, Yonkers, Assignors to Cox, Warren, Morrison & Co., Troy, N. Y.; patented Feb. 12, 1856.
7. For *Stove Plates*; Sanford Burnam, Assignor to Cox, Warren, Morrison & Co., Troy, N. Y.; patented Feb. 12, 1856.
8. For *Cooking Stoves*; Samuel Pierce and S. Burnam, Assignors to Cox, Warren, Morrison & Co., Troy, New York; patented Feb. 12, 1856.
9. For *Parlor Stoves*; William T. Coggeshall, Fall River, Mass.; patented February 19, 1856.

Claims to the above four patents, are for the ornamental designs as represented in the drawings."

MARCH 4, 1856.

1. For an *Improved Apparatus for Cooking with Quicklime*; W. W. Albro, Binghampton, New York.

Claim.—"The apparatus or device formed of the vessels."

2. For an *Improved Machine for Sweeping Streets*; Timothy Alden, Troy, New York.

Claim.—"1st, The arrangement and use of the sliding boxes, springs, and levers, in combination with the broom handles and crank-shaft, for the purpose of making the brooms self-adjustable under all circumstances, to overcome the inequalities of the pavements to be swept. 2d, The use of the guard board arranged longitudinally of the machine, for the purpose of collecting the dirt in winrows, in combination with the brooms for sweeping the dirt against the said guard board. 3d, The use of the collecting and elevating wheel, in combination with the guard board and revolving brush. 4th, The use and arrangement of the shield board, for the purpose of holding the dirt within the buckets of the collecting and elevating wheel, till ready to be discharged therefrom; hopper boards and endless carrying board, in combination with the connecting wheel."

3. For an *Improvement in Machines for Sawing Marble in Taper Form*; Christian Amazeen, New Castle, New Hampshire.

Claim.—"The jointed guide bars arranged so that two pairs of saw frames may be driven from one shaft, and one pair of saw frames be set if desired at different angles or degrees of obliquity from the other pair."

4. For an *Improvement in Manufacturing Hats*; James W. Beebee, Brooklyn, N. Y.

Claim.—"Making hats with a stiffened body, combined with a felt covering, reduced to the required form by felting, and put over and attached thereto with hatters' varnish or other equivalent adhesive substance."

5. For an *Improvement in Corn Harvesters*; William M. Bonwill, Camden, Delaware.

Claim.—"The two saws placed at the front part and at each side of the platform, in combination with the horizontal plates or beds and discharge rods."

6. For an *Improved Skein for Axle Arms*; John M. Burke, Danville, New York.

Claim.—"Constructing the skein of a metal plate which is bent in conical or taper form, with a space or opening in its upper part; the skein being secured to the arm by means of the bolts."

7. For an *Improvement in Ploughs*; James J. Cadenhead, Macon County, Alabama.

Claim.—"The adjustability of the brace in combination with that of the bar and that of the beam, for the purpose of regulating the pitch of the beam, and the height of the beam and handles, together or separately."

8. For an *Improved Shingle Machine*; Ransom Clifford, Lowell, Massachusetts.

Claim.—"1st, The combination of the driving bar attached to and moved by an endless chain, and the lever or levers, for the purpose of communicating motion to the shaving knives. 2d, The construction of the driving bar with the upright arms carried by the endless chains and chain gears, and its combination with the cross-bar and knives, in such a manner as that the driving bar shall be turned on its axis and be made to run clear of the knives just before it reaches them."

9. For an *Improved Arrangement of Steam Tubing for Regulating the Heating of Buildings*; Robert Cornelius, Philadelphia, Pennsylvania.

Claim.—"The arrangement of one section of the steam tubing within another section, whereby the steam tube itself is made to serve as a regulator and controller of the heat of the building."

10. For an *Improved Hinge for Shutters*; Isaac Davis, Groton, New York.

Claim.—"The use of the conical screw operating in combination with the wheel, held in position by and turning on the pin."

11. For an *Improvement in Harvester Rakes*; Owen Dorsey, Howard County, Md.

Claim.—"The combination with the rake arms, to which the rakes are firmly attached, of the vertical revolving shaft and cam way or guide, from which the rake arms receive an undulating motion in a vertical plane revolving about said shaft."

12. For *Self-acting Farm Gates*; Elon Dunbar, Philadelphia, Pennsylvania.

Claim.—"1st, The combination of the vibrating beams and railway with the lower bent and weighted lever upon which the flaps rest, and vibrating levers and rods for connecting them together, and the gate suspended on the railway. 2d, Constructing the gate in two parts, and suspending the lower part by the weighted lever, so as to enable the flap to draw said lower part downward during the raising of the upper main parts, to prevent a space for the passage of small animals being formed between the flaps and bottom of the gate. 3d, The combination of the series of parts, consisting of levers, rods, shafts, and radial arms, for operating the spring bolt, with the suspended gate."

13. For an *Improved Lubricator*; William E. Everett, City of New York.

Claim.—"1st, A stationary oil cup or reservoir in combination with a flexible tube, one of whose ends communicate with the cup, and the other with the surfaces to be lubricated. 2d, Giving motion to the spoons of a mechanical oil cup when it is used in combination with a flexible tube by means of a vibratory lever or its equivalent, which derives its motion from the tube itself."

14. For an *Improvement in Boot Crimps*; George Fetter, Philadelphia, Pennsylvania.

Claim.—"1st, The crimping of the upper leathers of boots, by confining and submitting them to the action of the leg and foot—the said leg and foot being jointed together at the instep. 2d, The radial adjustable guide, with its traversing pincers, in combination with the leg and foot."

15. For an *Improvement in Sheep Shears*; Luther B. Fisher, Coldwater, Michigan.

Claim.—"The so constructing of the shears as that the mere clasping of the hand or operating of the fingers in which the shears are held and controlled, shall produce a multiplied motion of the cutters."

16. For an *Improvement in Portable Houses*; Daniel Fitzgerald, City of New York.

Claim.—"1st, Constructing a house by inserting the weather-boarding ends into a channel at the corner-posts. 2d, The drawing together of the parts of the posts to secure the weather-boarding, it being held up against by nails or screws. 3d, The inserting the ends or tenons of the girders into the channel in such a manner that the weight of the chamber floor, roof, &c., may bear on the weather-boarding, and press the joints together, as it may shrink, or allow it to rise when it swells. 4th, The setting the girder in the same slot with the weather-boarding. 5th, Setting the floor plank ends in a channel in the girders or between the two halves of the girders, so that no nails are required, and so that the upper part of the girder will be the base of the room. 6th, The channeling the sides of the door and window frames, so that the weather-boarding can be inserted or taken out without the use of fastenings."

17. For an *Improvement in Supplementary Grating for Stoves, Furnaces, &c.*; B. F. Færing, Philadelphia, Pa.

Claim.—"Cleaning or removing foreign substances, such as slate, cinders, clinkers, &c., from stoves, furnaces, or other heating devices in which anthracite coal is burned, by means of the supplementary grating applied to the stove or furnace, or inserted within it."

18. For an *Improvement in Rifle Boxes*; F. R. Ford, Ophir, California.

Claim.—"The arrangement of the rifles in respect to the surface of the quicksilver."

19. For an *Improvement in Power Looms*; James Greenhalgh, Sr., Waterford, Mass.

Claim.—"1st, The combination with the method of balancing the bars, the method of giving motion to the shaft to operate the boxes by means of two notched bars, which are geared with opposite sides of the pinion on the said shaft, and are suspended from levers which are operated upon by a pattern cylinder, in such a manner as to raise either of the said bars, as may be necessary to bring its teeth into engagement with a dog suitably arranged and operated, to give the requisite motion to the bar. 2d, The method of giving the shuttle boxes a single or double movement as may be required by the pattern, by employing two hooks by having unequal movements—arranging the said hooks or their equivalents with their points at different elevations, and employing long and short studs in the pattern cylinder to raise the rack bars which give motion to the boxes to a position to be caught only by the hook having the longer movement. 3d, Controlling the order of the succession of the movements of the two pickers to make them act in regular alternate succession, or otherwise, as may be desirable, by means of a pattern cylinder acting upon the mechanism—by which movement is transmitted from the driving shaft to the pickers, in such a manner as to throw or retain either picker in gear with the said shaft and the other one out of gear. 4th, The combination of the levers through which the cams on the driving shaft operate the pickers, with the sliding shaft, the lever and the V shaped stud, the said lever being moved from side to side by the pattern cylinder, and the said V shaped stud receiving a suitable motion to operate on the said lever."

20. For an *Improved Guard for Coal Holes*; George C. Jenks, Boston, Mass.

Claim.—"A coal vault mouth guard made expansive and provided with means whereby it shall or may be expanded, while being elevated to a horizontal position above the opening of the vault—the said guard by such means being caused when it is raised into a horizontal position, to extend beyond the sides of the opening so as to lessen the danger of accident to pedestrians."

21. For an *Improvement in the Apparatus for Heating Buildings, by the Combination of, and Burning of Gas, Air, and Steam*; Charles H. Johnson, Boston, Mass.

Claim.—"The combination and arrangement of an air divider, (a closed box having a perforated diaphragm extending across it and receiving air from a pipe,) with one or more gas receiving chambers, and the air and gas mixers of the burner diaphragm of the same."

22. For an *Improvement in Weighing Scales*; James Kelly, Sag Harbor, N. Y.

Claim.—"The arrangement of the two screws, at opposite ends with, and forming part of, the double beam, in combination with the nuts and weights, all constructed and operating together for the separate and simultaneous adjustment of the tare and gross weights from fixed points or distances at opposite ends of the beam."

23. For an *Improvement in Stoves and Furnaces for Railroad Cars and other purposes*; Dennis G. Littlefield, Albany, New York.

Claim.—"A fire pot or furnace provided with a series of enlargements or projections on its side or sides, commencing at, and extending upwards from the grate to contain the fuel while it is being burned or during its consumption, open or provided with openings at the top for the escape of the gaseous products of combustion. Also, a grate made around a solid centre or disk. A supplying cylinder in combination with the fire pot or furnace and grate, or either of them."

24. For *Improved Bench Planes*; Ebenezer Mathers, Morgantown, Virginia.

Claim.—"The construction of bench planes with the stock in two pieces connected by a metal cap."

25. For an *Improvement in Railroad Car Seats*; George T. McLaughlin, Boston, Massachusetts.

Claim.—"Connecting the back of a railroad car seat with the body of the chair by means of springs and catches or their equivalents, whereby the back is made self-elevating when relieved from the catch which holds it. Also, in combination with the chair seat and its support, the annular ring, for the double purpose of a spring for the seat, and to prevent the seat from unnecessarily moving or rocking on its support when occupied."

26. For an *Improvement in Handle for Vise*; John T. Ogden, Boston, Mass.

Claim.—"Uniting the vise handle with the head of the screw by means of the swivel joint."

27. For an *Improvement in Scythe Rifles*; Eugene J. Post, Vienna, New Jersey.

Claim.—"Corrugating the surfaces of the scythe rifles."

28. For *Improved Method of Bottling Fluids under Gaseous Pressure*; Alphonse Quantin, Philadelphia, Pennsylvania.

Claim.—"The compound apparatus, composed of metal or other substances, to introduce a certain portion of a liquid into the apparatus, and force it out by the action of another liquid, gaseous or fermented."

29. For an *Improvement in Lamps for Burning Resin Oil*; Prentice Sargent, Newburyport, Massachusetts.

Claim.—"The annular air reservoir, in combination with the entry space and inwardly projecting lips, for the purpose of rendering the outer draft sufficiently constant to prevent the smoking of the lamp by any gusts of air or sudden movement to which the lamp may ordinarily be subjected. Also, the fine apertures or meshes opening into an outer chamber, in combination with said chamber, and with an inner perforated or recticular partition separating said chamber from the inner draft tube."

30. For an *Improvement in Machines for Pegging Boots and Shoes*; George Schuh and Phineas L. Slayton, Madison, Indiana.

Claim.—"1st, Feeding the boot or shoe to the plungers so that it may be punched and pegged by means of the combination of the screw, plates, shaft, frame, and pins. 2d, Punching the necessary holes in the sole and driving the pegs therein by means of the plungers fitted within separate cylinders—the points and awls on one plunger making the necessary holes in the sole at one stroke, and the other plunger being driven down and forcing the pegs in the sole by the plunger at its succeeding stroke. 3d, The friction block, operated by the cam, for the purpose of regulating the stroke of the plunger, and also the force of its blow."

31. For an *Improved Mode of Attaching Hubs to Axles*; Horace B. Simonds, West Hartford, Vermont.

Claim.—"Securing the hub upon the arm by means of the clutch, screw, and cap or box; the inner end of the clutch being of semi-cylindrical form and having a flanch on it, which flanch is fitted in a groove in the outer end of the arm, the screw passing through the outer end of the hub into the clutch; and the back part of the arm having a collar upon it, which collar is fitted in the back end of the hub; said collar being covered by a cap or box having a washer within it."

32. For an *Improvement in Air Escapes for Pumps*; Hiram Smith, Norwalk, Ohio.

Claim.—"The employment of tubes arranged to take the accumulating air from the top or upper portion of the receiving valve chambers and conduct it below the valve seats into the water discharge of the pump."

33. For an *Improvement in Gang Ploughs*; Aaron and Thomas S. Smith, Troy, Illinois.

Claim.—"Combining the axle and wheel with the bed piece."

34. For an *Improvement in Corn Shellers*; Jeremiah P. Smith, Hummelstown, Pa.

Claim.—"Grooving the shelling cylinder around its periphery, and extending the teeth of the breast beam therein, in combination with the arrangement for adjusting said breast beam to different degrees of inclination to suit the different conditions of corn to be shelled."

35. For an *Improvement in Tanning Apparatus*; Abraham Steers, Medina, N. Y.

Claim.—"The apparatus to charge the skins stretched on a frame, with a stratum of tan liquor."

36. For an *Improvement in Candle Dipping Machines*; Vincenzo Squarza, City of New York.

Claim.—"1st, The employment of intermittently rotating vertical wheels, carrying a number of wick frames, or wick holders, in combination with a rising and falling dipping trough. 2d, Keeping the dipping trough supplied to the proper level with tallow,

from a reservoir above by a valve, which is opened by the trough, or by some attachment thereto, every time it rises. 3d, The method of regulating the supply of tallow to the dipping trough, to make up exactly for the quantity taken therefrom by dipping, by the employment of two or more arms arranged at different elevations on a pivot attached to the trough, so that either one of them can be turned to a proper position to lift the valve in the reservoir. 4th, I claim the employment, for the purpose of tapering off the points of the candles, of a trough of hot water, into which the candles are plunged by the raising of the said trough, while the candles are stationary. 5th, The construction of the wick frames in pairs, each pair consisting of a shaft carrying two fixed bars, two sliding, to which are attached two pairs of clamping bars, and two wick boxes, all arranged so that each frame of the pair may, in its turn, be supplied with wick as required, to commence a new batch of candles. 6th, Constructing the draw plates in two parts, attached each to the jaw or jaws of one or more pairs of nippers, whether attached rigidly or to rollers fitted to the said jaws. 7th, The swinging frame with its jaws and rotary cutters, operating to take hold of the candles and cut them off when finished. 8th, The arrangement and combination of the table which carries the boxes, and the jaws which take the finished candles; that is to say, having both the table and jaws on shafts or centres, and gearing them together, so that they will move in such a way as to deposit the candles in the boxes gently and without injury."

37. For an *Improvement in Ships' Capstans*; Daniel and George Fallcot, Oswego, New York.

Claim.—"The arrangement of the ratchet fastened to the gear, with the ratchet on the barrel, and the traversing pawls in the head for the purpose of locking the head to, and releasing it from, each of the ratchets."

38. For an *Improvement in Guitars*; William B. Tilton, City of New York.

Claim.—"The combination of the bridge and rim of a guitar, or other stringed instruments, by a tail-piece being firmly attached to both, by which much of the strain is taken from the bridge-tree, and its size greatly reduced, by which the tone of the instrument is improved."

39. For *Improved Method of Adjusting Circular Saws*; Andrew L. Whiteley, St. Louis, Missouri.

Claim.—"The adjusting of the two saws at the same time towards each other, by means of the swinging arm and its set screws, and without allowing any end-play to the shaft. 2d, The combination of the device above claimed, with the devices for the purpose of adjusting the saw in every direction. 3d, So constructing the adjusting mechanism that it follows the shaft, when moved around on the arcs."

40. For an *Improvement in the Application of Soles to Boots and Shoes by means of Pressure and Gutta Percha, or other Cement*; Sylvanus H. Whorf, Roxbury, and Charles Rice, Boston, Massachusetts.

Claim.—"An improvement in the process of manufacturing and finishing shoes, with either gutta percha soles, or soles formed of leather or other material, and united to the upper and insole by means of gutta percha, and through the agency of pressing mechanism; our improvement consisting in applying heat within a last, by means of a chamber, and pipe, and steam, or means of heating said last, the same not only enabling the gutta percha of the sole to be softened, or rendered adhesive, while it is being pressed upon the insole and upper, but also serving to smooth and finish the upper."

41. For an *Improvement in Heading Bolts*; George Woodward, Brunswick, Maine.

Claim.—"The two oscillating shanks or levers, when combined with the suspended and bent toggles, and the perforated treadle."

42. For an *Improvement in Weighing Scale Beams*; William Yost, Goshen, Ohio.

Claim.—"The index marked from the centre, both right and left, together with the p, and its additions and weights, for grain measure."

43. For an *Improvement in the Construction of Grand Pianos*; Daniel F. Haasz, Philadelphia, Pa.

Claim.—"1st, The combining the action of grand pianos with a radiating key-frame, in such a manner as to enable me to use a deep and strong pin block. 2d, The key, with its projection and arrester, in combination with the lever and catches."

44. For an *Improved Mode of Constructing Cast Iron Pavement*; Peletiah M. Hutton, Troy, New York.

Claim.—"1st, Making an iron pavement of double thickness, or of two courses of iron plates, one resting upon the other. 2d, Fastening the two courses of iron plates together vertically, by means of the three-way adjustable key. 3d, Attaching the two courses of iron plates, laterally, by means of the pins cast on the upper surface of the lower plates, and the holes cast through the upper plates corresponding thereto. 4th, Also, the manner of forming and arranging the two courses of iron plates so as to produce the following results: That the joints formed by the edges with the upper course of plates are in no case parallel to the joints of the lower course of plates, and where the joints of the two courses of plates cross each other, they do so at right angles, in all cases."

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45. For an *Improvement in Railroad Car Brakes*; Vincent Barnes, Washington, District of Columbia.

Claim.—"The attaching the frame or brake to the truck by the parallel levers, so as to form a self-acting reversible brake."

46. For an *Improved Hot Blast Furnace*; La Fayette Blair, Painesville, Ohio.

Claim.—"The tunnels, diaphragms, division plate, and casing."

47. For an *Improvement in Valves for Lock Gates*; William Butler, Little Falls, N. Y.

Claim.—"The combination of the flanch valve and slide valve, when said flanch valve is hinged to the lower end of the valve."

48. For *Improved Ore Washer*; William L. Carter, Marietta, Pennsylvania.

Claim.—"A conical vessel, provided with shovels and pins, or projections, whose shaft is horizontal, and lower side inclined, so that water introduced at one end shall have a natural flow to the other end, and meet the ores as they pass in an opposite direction, to wash them."

49. For an *Improvement in the Manufacture of India Rubber Belting or Banding*; John H. Cheever, Boston, Massachusetts.

Claim.—"The improvement in the manufacture of rubber belting or banding, which consists in compounding the fibres of cotton or flax with india rubber."

50. For an *Improved Bench Clamp*; Clinton W. Clapp, Nappinger's Falls, New York.

Claim.—"The hook attached to the shank, which is formed of two parts, having beveled ends and connected; the shank being fitted in the groove in the bench, and used in connexion with the stationary hook."

51. For an *Improvement in Washing Machines*; Edwin B. Clement and Silas G. Willie, Burnet, Vermont.

Claim.—"The saw-teeth-shaped rubbers."

52. For an *Improved Apparatus for Heating Buildings by Steam*; Charles Davenport, Watertown, Massachusetts.

Claim.—"So connecting the float with the dampers of both the draft and smoke flues, by means of the chains, or their equivalents, that the pressure of steam within the boiler may be graduated to the temperature of the atmosphere, and the degree of heat required within the building. Also, so connecting the float, which actuates the dampers of the draft and smoke flues, with the cock which admits water from the supply cistern to the boiler, by means of the lever or its equivalent, that while the float is left free to rise to any required distance, it will open the cock whenever the water falls below its level."

53. For an *Improvement in Sewing Machines*; Henry R. David, City of New York.

Claim.—"The method of leading the thread, to avoid wear or derangement thereto, by combining with the slide in the patent of David M. Smith, of 16th April, 1850, on which this is an improvement, the needle constructed with two eyes, and the groove."

54. For an *Improvement in Machinery for Preparing Hemp and Flax*; Nancy Davy, Executrix of Edward Davy, deceased, Crediton, England; patented in England, November 13, 1852.

Claim.—"The reciprocating plate or plates, in combination with holding or retaining rollers, for effecting the separating of the fibres of the flax or hemp. Also, the combination of the hackle bar with the rollers and reciprocating breakers or plates."

55. For an *Improved Apparatus for Preventing Horses in Carriages from Falling*; Robert D. Dwyer, Richmond, Virginia.

Claim.—"The application of a suitable projecting frame, attached to the most convenient part of the carriage, or to the carriage or front axle, projecting over and between the horn or horns, sufficiently far, and at a suitable distance above, so that straps, chains, or other suitable fastenings, can be attached to the harness round the body of the horse, and to the collar."

56. For an *Improvement in Parallel Rulers*; R. Eickemeyer, Yonkers, New York.

Claim.—"Providing the ruler with a movable foot-piece and suitable stops."

57. For an *Improvement in the Preparation of Tallow for Making Candles*; François Gargin, Philadelphia, Pennsylvania.

Claim.—"The method of bleaching and purifying fat or tallow, for the purpose of making candles; the same consisting in the use of reduced nitric and sulphuric acids, alcohol, creta, gallica, slacked lime, camphor, borax, egg-shells, and oil of lemon."

58. For an *Improvement in Spark Conductors for Locomotive Trains*; Peter C. Guiou, Cincinnati, Ohio.

Claim.—"The yoke with the springs and the frame, so that the pipe shall have free space and liberty to play by the yielding of the springs, to accommodate the rocking motion of the cars, or the up and down motion, without cramping or injuring the pipe, and also to give room for the back and forward motion allowed by the car coupling."

59. For an *Improvement in Tanning*; R. Gould, Whitewater, Wisconsin.

Claim.—"To have discovered, that in order to insure the proper exercise of the properties of substances in tanning, they must be used in a certain manner, differing from the mode in which they have hitherto been known to be used. Also, to have discovered, that in order to use these substances effectively for tanning, they must be employed substantially according to the processes set forth in my application. Also, to have discovered, that when these three substances, or their chemical equivalents, have been employed together, they have and must fail, as they are, to some extent, incompatible, when so used. Also, the use, in the process of tanning of hides and skins, for the making of leather, of the two solutions described, and applied, each separately or at different times, and in the order following, viz: 1st, By using a combined solution of catechu, (or any other material, its equivalent, as containing the tannin properties,) and saltpetre. 2d, By using a combined solution of catechu, (or any other material, its equivalent, as containing the tannin properties,) and alum."

60. For an *Improvement in Carriage Tops*; Henry Hays, Quincy, Illinois.

Claim.—"The plate or circle, having the flat iron of the front bow projecting from it, working on a pinion in the standard, in connexion with a spring latch or pawl, fitting into notches in the plate, by means of which the top of the carriage is sustained in an elevated or half elevated position."

61. For an *Improvement in Machinery for Ironing Hats*; Samuel A. Kinsman and Samuel Field, Barré, Massachusetts.

Claim.—"Arranging the cam, so that when operated by the gear, it will control the vertical movement of the hat-block, through levers, in combination with the lever to control the lateral movements of the hat-block, and thus secure the adequate pressure on all parts of the hat at one time."

62. For an *Improvement in Harvester Cutters*; Israel S. Love, Beloit, Wisconsin.

Claim.—"The use of the clearing tooth, in connexion with the cutting tooth, provided with cutters distinct, and the spaces between them, continue back to the rear of the cutter bar. I do not limit myself to the exact form or proportions of cutter, for it is evident that either of them might be slightly varied, without materially altering the effect."

63. For an *Improved Spirit Blow Pipe*; Horatio N. Macomber, Lynn, Mass.

Claim.—"Combining with a vapor jet of a spirit blow pipe an air jet, that air may be blown from the lungs of a person, directly into the inflamed current of said vapor jet, in order to control, elongate, or reduce said current and increase its heating powers. Also, arranging the air jet concentrically within the vapor jet, in order that the effluent current of air may pass into a hollow tube, or stream of vapor or flame. Also, combining with each main jet tube, a lighting vapor jet tube."

64. For an *Improvement in Mowing Machines*; Jacob J. Mann, Westville, Indiana.

Claim.—"The construction of the reel frame, the same being braced by the rod, and the suspension of the reel, at the outer extremity of the shaft by the pendant."

65. For an *Improved Method of Bending Wood*; John C. Morris, Cincinnati, Ohio.

Claim.—"The clamps to prevent end expansion, and the levers, working on fixed fulcrums, when in operation."

66. For an *Improvement in Revolving Fire Arms*; Frederick Newbury, Albany, New York.

Claim.—"The combination of the wheel, gearing, and pawl, with the trigger, by which means the block is revolved. Also, the priming cap magazine, in combination with the trigger, to permit the capping of the cone by the trigger. Also, the spring guard plate, to prevent the fire from the upper chamber extending to the lower. Also, the combination of the picker attached to the hammer, with the apparatus operated by the thumb, in the act of cocking the hammer."

67. For an *Improvement in Carriage Hubs*; Henry Nycum, Uniontown, Penna.

Claim.—"A hub, composed of a back and front section, and having a thin metallic tube or ring independent of each, centrally placed between them, against which the inner ends of the spokes abut, when said sections are so made, that in removing the back one, the pipe or box of the hub shall also be removed or removable with it, to facilitate the properly introducing of a new spoke."

68. For an *Improvement in Steam Boilers*; Leonard Phleger, Tamaqua, Penna.

Claim.—"1st, The arrangement of the arched water space, so that the boiler may be suspended near to the track. 2d, The arrangement of the arched water space—the water space—and the water table in combination, so that the flame and heat will be reverberated."

69. For an *Improvement in Grain and Grass Harvesters*; Benjamin T. Roney, Philadelphia, Pennsylvania.

Claim.—"The gear frame with its lugs and beveled projections."

70. For an *Improvement in Straw Cutters*; Edwin P. Russell, Manlius, N. York.

Claim.—"1st, The wheels with the rim cams on the inside of the rim, in combination with friction rollers, for raising the box, with the knife attached, and causing it to pass the edge of the stationary knife, which is placed in such a position as to give them the shear cut. 2d, Setting the box at any angle of about 45 degrees, and hung on a hinge or pivot, with a joint or hinge in the bottom, for feeding the straw to the knives, and for allowing the knife to cut."

71. For an *Improvement in Lime Kilns*; Job Sands, Sands' Mills, N. York.

Claim.—"Having the fire chamber of the kiln so constructed, that the bottom will be but a short distance below the door, no grate bars being employed, and having an aperture made through the door, so that the air that feeds the fire will act horizontally upon it and nearly in line with the openings."

72. For an *Improvement in Puddling Iron*; Richard Savary, Steubenville, Ohio.

Claim.—"The arrangement of the cupola and puddling furnaces."

73. For an *Improved Method of Straining Mulley Saws*; Theodore Sharp, North Greenbush, New York.

Claim.—"Straining the saw, by attaching its ends to a pivoted elastic bar."

74. For an *Improvement in Apparatus for Heating or Cooking by Gas*; William F. Shaw, Boston, Mass.

Claim.—"The application of a cone or dome, formed of wire gauze, or pierced metal, to an ordinary wire gauze gas burner, for burning mixed gases and air, in combination with an outer cylinder of wire gauze, or pierced metal, for the supply of atmospheric air, divided into jets."

75. For *Improved Boxes for Axles*; Alfred E. Smith, Bronxville, New York.

Claim.—"The combination of two or more longitudinal narrow slots, cut in the direction parallel to the axis of the box, with enlarged longitudinal cavities."

76. For a *Mortising and Boring Machine*; George N. Sterns, Syracuse, New York.

Claim.—"1st, An adjustable cam, in combination with levers, spring, pawl, pinions, and rack. 2d, The use of the spring, or its equivalent, to move the clutch which gives the return motion to the auger."

77. For an *Improved Mode of Securing Thills to Axles*; Matthias Soverel, Orange, New Jersey.

Claim.—"The combination of the spiral spring and the catch or nut, and the eye of the bolt, and the spring chamber and slots."

78. For an *Improvement in Apparatus for Making Extracts*; Abraham Steers, Medina, New York.

Claim.—"The displacing apparatus, in connexion with the application thereto of heating and cooling agents, viz: the said apparatus being composed of the percolator and the receiver, separated from each other by means of a perforated diaphragm, or its equivalent, the said percolator having its upper end closed by a metallic cover, supplied with an outwardly opening valve, at the same time that the top of said percolator is connected directly with the said evaporating receiver, by means of a pipe, supplied with a valve or a stop-cock, by which arrangement, the contents of said percolator can be operated upon, first by steam generated in the evaporating receiver, and then by the percolation of the menstruum after it has been evaporated and condensed again."

79. For an *Improvement in Means for Reducing the Friction of Slide Valves of Steam Engines*; Robert L. Stevens, Hoboken, N. J.

Claim.—"The box or balance block, in combination with an ordinary slide valve—said balance block having around the edges of its upper face, ledges, which project upward, and are made to fit (around the whole upper face) into a recess in the follower, and formed by double ledges projecting down from, and enclosing, which recess has an india rubber packing in its bottom, against which the said ledges are made to pack steam tight, together with another india rubber joint at the bottom of another similar recess formed by the ledges and a part of the bonnet, into which latter recess, one of the ledges of the follower fits tight in the same manner as the ledges fit in the recess."

80. For an *Improvement in Revolving Fire Arms*; William Mt. Storm, City of New York.

Claim.—"1st, Extending the "casque" forward as far as the face of the cylinder, and surrounding it to form a receptacle or holder for it, while loading, in combination with a hinged apron piece. 2d, In combination with the so arranged barrel and casque, and for locking them together, the solid "self-acting locking spring, (as distinguished from a locking lever, having by necessity a hinge to wear loose, &c.,) said spring being arranged to resist the discharge by its direct tensile strength. 3d, In combination with the casque, or cylinder receptacle, the "safety-screw," projecting into the recess between the shoulders, (or as equivalent, the screw on the cylinder, and the shoulders on the "casque,") to prevent the cylinder from getting dropped, while loading or capping in action. 4th, The central revolving shaft, with the button head forward of the sleeve, and both projecting within the central cavity of the cylinder, beyond the line of its rear and the fire of the cap, in combination with a revolving wheel, located within the stock, enclosed from the fire and smoke. 5th, In combination with the "dog," having an inclined plane or projection at its forward end, to meet the purpose of such combination, an adjustable "tripping screw," whereby despite of wear, &c., the detachment of the "dog" from the sear, may be effected sooner or later, in accordance with the needed distance of revolution of the many chambered cylinder. 6th, Extending the rear of said "dog" downward from where it connects to the heel of the hammer, and connecting the "pawl"

directly thereto, by which means, the pull on the dog by the trigger, directly operates the parts to push around the cylinder. 7th. Extending the pawl beyond where it is connected to the downward extension or heel of the dog, and connecting the main spring to the part so extended, by which means the pull of the dog on the pawl, distends the main spring, while the latter being distended, presses the point of the pawl more firmly into the revolving holes or indentations in the face of the revolving wheel, preventing any slip, while the revolving cylinder in all points, rendering the use of a pawl spring unnecessary. 8th. Pivoting the usually fixed end of the main spring, so that while stationary, it shall not be fixed, but free to compensate for its own vibration, and that of the rear of the pawl, thus rendering the use of the usual vibrating or connecting "link" between the main spring and the rest of the block unnecessary, despite of the immediate connexion of the main spring to said pawl. 9th. The locking notches in the revolving wheel, or its equivalent, in combination with the "crest" on the dog, for the purpose of securing the stoppage and locking fast of the cylinder, at the proper position for discharge. 10th. In combination with the forward shoulder or detent on the head or sear of the trigger, the screw projections or detent on the rear of the head or sear of said trigger, to the end, that after said forward detent or hook ceases to act, by the dog being thrown off to lock the revolving wheel, and thereby, the cylinder in place, the hammer shall not immediately fall, but be retained "on cock" to give opportunity for deliberate aim as explained, said rear projection or detent catching at this point on the downward prolongation of the heel of the hammer, for this purpose, the whole being arranged and acting in conjunction."

81. For a *Machine for Cutting Irregular Forms*; Henry D. Stover and James W. Bicknell, Boston, Mass.

Claim.—"Combining the guide with the bearing, and also combining the cutter head with this guide, in such a manner that they shall move up and down together. Also, the combination of the cutter head, arbor and pivoted bearing, so as to allow the cutting angle of the knives to be varied in relation to the table, and also, combining them with the mechanism for varying that angle gradually in the cutting process."

82. For an *Improvement in Harvester Cutters*; Pliny Thayer, Lansingburg, N. Y.

Claim.—"In combination with the plates lying loosely on the fingers or guards, but kept from moving, by the projections of the plates, and the open countersinks on the guards, the cutters which are vibrated past those, and held to them by the guides and springs."

83. For an *Improved Plane Stock*; John B. Thomas, Cincinnati, Ohio.

Claim.—"The glass face, combined with the case or ferrule, or its equivalent."

84. For an *Improved Wrench*; Erastus Tracy, Troy, New York.

Claim.—"Making the movable jaw in two sections pivoted together, one of which sections contains the shank, and the other forms the clutch, by which the whole jaw is held to the shank, and both sections made united."

85. For an *Improved Fountain Pen*; A. F. and C. M. H. Warren, Brooklyn, N. Y.

Claim.—"1st, Having the piston and rod arranged, so that the piston may be detached from the rod, when the tube or fountain is filled with ink. 2d, Attaching the pen directly to the lower end of the tube by the band, conducting the ink from the tube to the back or convex side of the pen, by the wire which is attached to the pen, and passes through the apertures. 3d, The plate attached to the back or convex side of the pen, in combination with the wire, for the purpose of ensuring a regular and even supply of ink to the pen."

86. For an *Improved Machine for Cutting Out and "Skiving" the Soles of Boots and Shoes, and also for Cutting the "Rands" therein*; William Wells and Mellen Bray, Turner, Maine.

Claim.—"Operating the knife, which is attached to the bar, by means of the lever rod, with plate attached, on which plate the bar rests, and the ledge on the heel of the stock. Also, the knives, when attached to, or connected with, an elastic platform."

87. For an *Improved Dove-tailing Machine*; Edwin Wight, Philadelphia, Penna.

Claim.—"The cutting of dove-tails of exactly similar size and form, on the edges of a number of boards, at one operation, by placing said boards one upon the other, and submitting them to the action of revolving and traversing cutters."

88. For an *Improvement in Grain and Grass Harvesters*; Abner Whitely, Springfield, Ohio.

Claim.—"1st, The narrow divider. 2d, Making the divider with that portion forming the under or upper side of the slot removed as the case may be. 3d, Terminating, the shoe at or near the point of the blade which cuts against it, to prevent it carrying grass. 4th, Extending of the tops of the guards over the edges of the lower portions. 5th, The double cap, *i. e.*, the caps of two guards in one piece, having one shank for attaching it to the finger piece. 6th, Attaching the shanks of the guard caps to the finger piece, for the purpose of preventing straws or blades being carried beyond them to cause clogging. 7th, Terminating the points of the finger or fingers, at or near the points of the blades. 8th, Making one side and also one edge of the cutter bar, or either of them, a rasp or rough surface."

89. For an *Improved Faucet*; Moses Woodbury, Boston, Mass.

Claim.—"The combination of the handle with the stem, and the spring, when the latter is placed behind the valve."

90. For an *Improvement in Leather Splitting Machines*; Elisha Pratt, Assignor (through Pratt & Upton) to E. Pratt & Thomas P. Pingree, Salem, Mass.

Claim.—"So hanging and arranging the lower roll, by means of the levers, connecting rods, and plates, that it may be depressed when required, for the purpose of relieving and adjusting the hide."

91. For an *Improvement in the Manufacture of Umbrella Ribs*; Charles C. Reed, Assignor to self, William S. Reinert and Jacob Schnell, Philadelphia, Penna.

Claim.—"The manufacture of umbrella ribs, by grooving a cheap material, such as hickory, bamboo, or rattan, and securing within the groove a strip of whale bone."

92. For an *Improvement in the Manufacture of Boot and Shoe Soles*; Lorenzo Stratton, Feltonville, Mass., Assignor to self and Luther Hill, Stoneham, Mass.

Claim.—"The improvement in the manufacture of boot and shoe soles, viz: striking them up in nuts between formers and counter formers."

93. For an *Improvement in Sewing Machines*; William C. Watson, Assignor to Ira W. Gregory, City of New York.

Claim.—"1st, The tongue or spring, in combination with the needle, for insuring the formation of loops on one side only. 2d, The gripper, for seizing the thread and holding it, until the needle has entered the cloth, thus securing the last stitch against slacking up."

94. For an *Improved Method of Boxing Carriage Wheels*; Charles Schmidt, Union, Maine.

Claim.—"The method of boxing carriage wheels."

MECHANICS, PHYSICS, AND CHEMISTRY.

*Manufacture of Steel by Electricity.**

In contradistinction to the ordinary method of manufacturing steel, it may now be stated that a process has been discovered of converting iron into steel by a current of electricity passed through the iron when placed in a furnace, and embedded in charcoal, whereby an immense saving of both time and fuel is the more immediate result. The furnaces used in the instance now referred to, were fitted with two distinctly separate and independent compartments or boxes. One was filled with the common Swedish or bar iron, and the other with scrap and bar iron, indiscriminately mixed in about equal proportions: the former was intended to be

*From the London Mining Journal, No. 1047.

not so highly carbonized as the latter. The battery was placed, and generally so arranged, that the electric current should pass either through both, or through only one, of these compartments respectively, as required. After the furnace had been brought to the proper temperature, which occupied the usual time, the battery was set in action: the electric current was passed through both boxes simultaneously for 24 hours, when a trial bar was drawn from the box which contained the bar iron required in only the lesser degree to be carbonized. From the various tests to which this bar was subjected, it was found to be sufficiently carbonized, or converted into steel, although it was deemed expedient that the action of the current of electricity should be continued during another six hours, for "soaking," making the entire period 30 hours continuously. The current was then applied to the remaining box or compartment alone for 72 hours in addition, at the expiration of which time the action of the battery was suspended, and the furnace was allowed gradually to cool. Highly carbonized steel was found to have resulted, which was thus produced through continuous electrical agency. That quantity of iron which for the longest period had been subjected to the electric current was found in the highest degree to possess the respective qualities of hardness and carbonization. On the second experiment, which was intended to reduce the operation of the manufacture of steel within the nearest possible limit of time, the furnace, accordingly, was charged with foreign iron required to be highly carbonized, of a quality fitted (say) for the manufacture of files. On subjecting the furnace to the customary heat (the usual time being 64 hours firing,) the electric current was applied, and maintained in continuous action during the space of 48 hours, at the end of which time the battery was taken off, and the firing carried on for six hours longer. A trial bar was then drawn from the furnace, after the battery had been in action during 45 hours; and, from the appearance which the metal then presented, it was judged to have been sufficiently carbonized, excepting that six hours' extra firing was allowed for what is technically termed "soaking," or, rather, for the diffusion of carbon throughout the integral substance of the iron, which, in the process of converting, is received in the greater or lesser degree—in some places more than in others. After the necessary time had been allowed for cooling, the steel was taken out of the furnace, which discovered that portions of the metal were wanting in the required uniformity, whereas others possessed an undue degree or amount of hardness, which showed that either the battery was not applied at a sufficiently early stage, or that a few hours were wanting in the "soaking" process. It was, however, concluded that, had this operation been continued for six, or even for twelve hours longer, the result would have secured more perfect uniformity throughout the entire bulk of metal, and a saving, by this process of manufacture through the continuous electric current, amounting to at least 20 per cent. in labor, time, and fuel.

The results of these experiments have, however, demonstrated that, in the manufacture of iron, the agency of electricity can be applied with immense advantage, since there is every reason to conclude, that iron can now be made through this process, even from ores, equal in purity to the finest iron at present imported. On the other hand, in the operation of

the conversion of iron into steel, it will give a greater power of governance to the operators, inasmuch as the application of the battery for a certain time will ensure a certain amount of carbon being taken up, absorbed, or concentrated and amalgamated with the iron; and thus, by increasing or diminishing the action of the battery, different qualities of steel will be produced, with a certainty, regularity, and efficiency which, hitherto, under the ordinary process of manufacture, has been the object wanting—the great desideratum sought after, as well as the end desired to be attained. The experiments were conducted at Sheffield, under the superintendence of Mr. Hunt, and in conjunction and conference with Messrs. Atkinson, of that place. If, on a more extended scale, the electric process should be found practicable, we may yet have cast iron mortars, guns, and ordnance, at once carbonized into steel, and lowered in rigidity, toughness, and ductility, as well as in tensile properties, to any degree or amount of temper.

On Working Steam Expansively in Marine Engines. By Mr. E. ALLEN.*

(Continued from page 202.)

It is proposed now to consider the effect of increasing the size of the engines for expansive working, as regards the *total weights* carried; and the following Table XV. gives the relative increase of weight resulting from an ordinary engine being increased in size from 1 to $1\frac{1}{2}$, 2, $2\frac{1}{2}$, and 3 times; also the proportionate quantity of coal consumed in a given time; the saving in weight of coal balancing the increase in weight of engines, where the proportion of coal is large. The two last columns give the ratios of time, and the proportionate number of days the coal would last in the respective cases, if the gross weights carried were kept the same.

The general results may be given as follows; that when the size of the engines is doubled, the gross weights of machinery and coal together are

	Increase.
Increased in Class 1, from 1.25 to 1.68 equal to 34	per cent.
“ in Class 2, from 2.00 to 2.21 equal to $10\frac{1}{2}$	“
“ in Class 3, from 2.50 to 2.56 equal to $2\frac{1}{2}$	“

and are

	Decrease.
Decreased in Class 4, from 5.00 to 4.34 equal to 13	per cent.
“ in Class 5, from 8.00 to 6.47 equal to 19	“

Also, when the size of the engines is increased to 3 times, the gross weights of machinery and coal together are

	Increase.
Increased in Class 1, from 1.25 to 2.14 equal to 71	per cent.
“ in Class 2, from 2.00 to 2.57 equal to $28\frac{1}{2}$	“
“ in Class 3, from 2.50 to 2.85 equal to 14	“

and are

	Decrease.
Decreased in Class 4, from 5.00 to 4.28 equal to 14	per cent.
“ in Class 5, from 8.00 to 5.99 equal to 25	“

* From the Lond. Mechanics' Mag., Aug., 1855.

TABLE XV.

Table showing the Proportionate Weights of Machinery and Coal, and Joint Weights of same, when the size or Nominal Horse-Power of Engines is varied (Indicated Horse-power supposed the same in all cases respectively).

Class.	Service.	Ratios of Nominal Horse-power	* Ratios of Weight of Machinery corresponding to Increase of Nominal Horse-power.	Ratios of Weight of Coal corresponding to Increase of Nominal Horse-power.	Ratios of Total Weights	Ratios of Time the Coal would last if the Total Wts. be kept the same.	Ratio in Days.
1	River.	1	1.00	.25	1.25	1	2½
		1½	1.25	.20	1.45	..	..
		2	1.50	.18	1.68	..	..
		2½	1.75	.16	1.91	..	..
		3	2.00	.14	2.14	..	..
2	Coasting and Continental.	1	1.00	1.00	2.00	1.00	10
		1½	1.25	.81	2.06	.92	9
		2	1.50	.71	2.21	.70	7
		2½	1.75	.63	2.38	.39	4
		3	2.00	.57	2.57	.00	0
3	Ocean (Short Voyages) and Government.	1	1.00	1.50	2.50	1.00	15
		1½	1.25	1.21	2.46	1.03	15½
		2	1.50	1.06	2.56	.94	14
		2½	1.75	.94	2.69	.80	12
		3	2.00	.85	2.85	.59	9
4	Ocean (Long Voyages) Australian.	1	1.00	4.00	5.00	1.00	40
		1½	1.25	3.24	4.49	1.15	46
		2	1.50	2.84	4.34	1.23	49
		2½	1.75	2.52	4.27	1.29	51½
		3	2.00	2.28	4.28	1.31	52½
5	Ocean (Voyages out and home,) Eastern Steam Navigation Company.	1	1.00	7.00	8.00	1.00	70
		1½	1.25	5.67	6.92	1.19	83
		2	1.50	4.97	6.47	1.30	91
		2½	1.75	4.41	6.16	1.41	99
		3	2.00	3.99	5.99	1.50	105

* The boilers, water, wheels, or screw are supposed the same, and the engines alone equal to half the gross weight of machinery.

The last columns show that in the 4th Class, where the weight of coal carried is equal to four times the gross weight of machinery, if the size of the engines be doubled, the same gross weight being taken, then the coals will last nine days longer—equal to 22 per cent. increase; and if the size of the engines be increased to three times, and the gross weight carried be kept the same, then the coal will last 12½ days longer—equal to 31 per cent. increase.

Also, in the 5th Class, where the weight of coal carried is equal to seven times the gross weight of machinery, if the size of the engines be doubled, the gross weight being kept the same, then the coal will last 21 days longer—equal to 30 per cent. increase; and if the size of the engines be increased to three times, and the gross weight carried be kept the same, then the coal will last 35 days longer—equal to 50 per cent. increase.

The last part of the subject to be now considered is, the effect which

the increase in the size of the engines has upon the *total spaces* occupied by machinery and coals together. Table XVI. gives the results, where the size increases from one to one and a half, two, two and a half, and three times, for the three divisions into which the five classes of vessels, before spoken of, are reduced.

In Class 1 the coals occupy a space *equal* to that occupied by the engines alone; in Classes 2 and 3, *three times*; and in Classes 4 and 5, *five times* the space occupied by the engines alone.

The space above spoken of is horizontal space, taken at the greatest beam of the vessels.

The general results are, that if the size of the engines be doubled, then the total space occupied by machinery and coals taken together (the coals lasting the same time in all cases),

In Class 1, increases from 4·00 to 4·21, equal to 5 per cent.

In Classes 2 and 3, decreases from 6·00 to 5·63, equal to 6 “

In Classes 4 and 5, decreases from 8·00 to 7·05, equal to 12 “

Also, if the size of the engines be increased three times, then the total space occupied by machinery and coals taken together,

In Class 1, increases from 4·00 to 4·57, equal to 14 per cent.

In Classes 2 and 3, decreases from 6·00 to 5·71, equal to 5 “

In Classes 4 and 5, decreases from 8·00 to 6·85, equal to 15 “

TABLE XVI.

Table showing the Relative Spaces occupied by Engines, Boilers, and Passages, and Coals, separately and together; the size of Nominal Horse-Power increasing from 1 to 3; the Actual or Indicated Horse-Power remaining the same.

Class.	Service.	Ratios of Size or Nominal Horse-power.	Ratios of Spaces occupied by Engines alone. *	Spaces occupied by Boilers and Passages (Constant.) †	Ratios of Spaces occupied by Coals. ‡	Ratios of Total Spaces.
1	River.	1	1·00	2	1·00	4·00
		1½	1·25	2	·81	4·06
		2	1·50	2	·71	4·21
		2½	1·75	2	·63	4·38
		3	2·00	2	·57	4·57
2 and 3	Coasting and Continental and Ocean (Short Voyages.)	1	1·00	2	3·00	6·00
		1½	1·25	2	2·43	5·68
		2	1·50	2	2·13	5·63
		2½	1·75	2	1·89	5·64
		3	2·00	2	1·71	5·71
4 and 5	Ocean (Long Voyages) and Eastern Steam Navigation Company's Vessels.	1	1·00	2	5·00	8·00
		1½	1·25	2	4·05	7·30
		2	1·50	2	3·55	7·05
		2½	1·75	2	3·15	6·90
		3	2·00	2	2·85	6·85

* The actual horizontal space occupied by engines may be taken generally at $\frac{1}{3}$ square foot per nominal horse-power.

† The actual space occupied by boilers may be taken at 1 square foot per nominal horse-power, and passages at $\frac{1}{3}$ square foot.

‡ The space occupied by the coals varies,—Class 1, $\frac{1}{3}$ square foot; Classes 2 and 3, $2\frac{1}{3}$ square feet; and Classes 4 and 5, $3\frac{1}{3}$ square feet per nominal horse-power.

Ratios—Engines, 1; Boilers and Passages, 2; Coals 1, 3, and 5 respectively.

Table XVII. shows how the *cargo space* is diminished or increased under the three suppositions, that the machinery and coal space is *equal* to the cargo space, or to *two-thirds*, or to *one-half* the cargo space; these proportions embracing the ordinary limits.

TABLE XVII.

Table showing the *Per Centage of Loss or Gain in Cargo Space, and the Per Centage of Saving in Quantity of Coals required, when the size or Nominal Horse-power of the Engines is Increased, the Indicated Horse-power being the same.*

Ratios of Total Spaces occupied by Machinery and Coals (from foregoing Table.)	The same Ratios, but showing the per centage of increase or decrease.	Per Centages in which the Cargo Space is Diminished or Increased.			Ratios of Coals consumed in the same time, and developing the same Power.	Per centage of Coal saved by Expansive Working.
		1st. When the total Machinery and Coal Space is equal to the total Cargo Space.	2d. When the total Machinery and Coal Space is $\frac{2}{3}$ of the total Cargo Space.	3d. When the total Machinery and Coal Space is $\frac{1}{2}$ of the total Cargo Space.		
4-00	100	Diminishes Per Cent.	Diminishes Per Cent.	Diminishes Per Cent.	100	Per Cent.
4-06	101 $\frac{1}{2}$	1 $\frac{1}{2}$	1	$\frac{2}{3}$	81	19
4-21	105	5	3 $\frac{1}{3}$	2 $\frac{1}{2}$	71	29
4-38	109	9	6	4 $\frac{1}{2}$	63	37
4-57	114	14	9 $\frac{1}{3}$	7	57	43
6-00	100	Increases Per Cent.	Increases Per Cent.	Increases Per Cent.	100	Per Cent.
5-68	94	6	4	3	81	19
5-63	94	6	4	3	71	29
5-64	94	6	4	3	63	37
5-71	95	5	3 $\frac{1}{3}$	2 $\frac{1}{2}$	57	43
8-00	100	Increases Per Cent.	Increases Per Cent.	Increases Per Cent.	100	Per Cent.
7-30	91	9	6	4 $\frac{1}{2}$	81	19
7-05	89	12	8	6	71	29
6-90	86	14	9 $\frac{1}{3}$	7	63	37
6-85	85	15	10	7 $\frac{1}{2}$	57	43

If the engines be doubled in size, then

In Class 1, the cargo space diminishes 5, 3 $\frac{1}{3}$, and 2 $\frac{1}{2}$ per cent.

In Classes 2 and 3, " " increases 6, 4, and 3 " "

In Classes 4 and 5, " " increases 12, 8, and 6 " "

If the engines be increased in size three times, then

In Class 1, the cargo space diminishes 14, 9 $\frac{1}{3}$, and 7 per cent.

In Classes 2 and 3, " " increases 5, 3 $\frac{1}{3}$, and 2 $\frac{1}{2}$ " "

In Classes 4 and 5, " " increases 15, 10, and 7 $\frac{1}{2}$ " "

The last column gives the per centage of saving in coal.

The effects of *increasing the size* or nominal horse-power of engines, for the purpose of working the steam more expansively, have now been considered, in respect both to the *increased first cost of machinery*, so far at least as the interest on the increased capital is concerned, the *saving of coal* in per centage of capital, the *increase of weight of machinery* and the *saving in weight of coal*, and also in respect to the *total spaces occu-*

piel by machinery and coal, and also the effect of the changes on the *cargo space* in per centage of the first supposed cargo space; and it is considered that the results are such as are not generally known, and that merchants and ship-owners are wholly unaware of the advantages of working steam expansively, even should they be compelled at the outset to pay double the amount now usually paid for engine power.

It would appear certain that if no alternative existed but that of increasing, say the diameter of the cylinders of marine engines, and thus increasing the first cost in about the proportion of $1\frac{1}{2}$ times for double the size, and 2 times for 3 times the size, (the boilers, wheels, or screw being supposed to remain the same,) ample reason still exists for making such a change in contracting for engines intended for vessels carrying a large proportion of coal; and it has been shown that if double the ordinary amount be paid for the machinery, yet $9\frac{1}{4}$ per cent. increase may be paid upon the capital in some cases, after deducting for the extra cost of engines, by the economy in coal alone.

It has also been shown that notwithstanding the increased size of engines (supposed to be increased three times,) the Australian vessels carrying a large proportion of coal, present opportunities of gaining 15 per cent. in many cases in cargo room, and further, that about 14 per cent. may be saved in the gross weights carried, taking machinery and coals together; or that so much more additional coal could be taken for a longer voyage without re-coaling.

In the foregoing Tables, the size or nominal horse-power of engines has been supposed to be increased three times, as a limit, but no advantage has been named as resulting from the diminished cost of the boilers, since, less steam being required to develop the same power, smaller boilers would suffice. Considerable advantage, however, would follow from this reduction; or advantages might be shown, in decrease of weight and space in the boilers; but it has been considered best not to encumber the calculations with so many considerations.

The gain in cargo space is altogether an additional saving to that already named as resulting from economy in quantity of coal, but this source of profit has only been shown in a per centage of increase of cargo space, and no money value can be set upon it, as it varies so much with the nature of the trade and freight obtained.

The following Table, XVIII., presents a general summary of what has been before stated, and it will be seen from this Table, that until the quantity of coals taken in proportion to weight of machinery at least equals $1\frac{1}{2}$ times, as in Class 3, or rather until it equals two times the gross weight of machinery, no change could be advantageously made by increasing the nominal horse-power or size of the engines; inasmuch as (on the conditions assumed) the weight of the machinery increases more rapidly than the weight of the coal diminishes.

In Classes 4 and 5, however, an *increase in the weight of the engines* is soon covered by the *reduction in weight of coal* required.

TABLE XVIII.—GENERAL SUMMARY.

Table compiled from the foregoing Tables, the size or Nominal Horse-power increasing from 1 to 2 and 3 times (the intermediate sizes being omitted,) and based on the supposition that in order to work expansively the Engines must be increased in Cost, Weight, and Size, the Boilers being assumed to remain the same. The Steam Pressure supposed at only about 20 lbs. above the atmosphere.

Class.	Service.	Ratio of Size or Nominal Horse-power.	Saving in Coal in per centage of capital.	Increase of Capital per cent.	Total Weights of Coal and Machinery—Increase or Decrease per cent.	Total Spaces occupied by Coal and Machinery—Increase or Decrease per cent.	Cargo Space, Decrease or Increase per cent.			Per Centage of Increase of Time the Coals would last, if the Total Weights be kept the same.	No. of Days the Coals will last, if Total Wts. be kept the same.
							When Total Machinery and Coal Space is equal to Cargo Space.	When Total Machinery and Coal Space is $\frac{2}{3}$ of Cargo Space.	When Total Machinery and Coal Space is $\frac{1}{2}$ of Cargo Space.		
			Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Days.
1	River	1	...	...	Increases	Increases	Decreases	Decreases	Decreases	...	$2\frac{1}{4}$
		2	4.55	30	34	5	5	$3\frac{1}{3}$	$2\frac{1}{2}$	...	...
		3	6.45	60	71	14	14	$9\frac{1}{3}$	7	...	...
2	Continental	1	...	...	Increases	Decreases	Increases	Increases	Increases	...	10
		2	1.45	20	$10\frac{1}{2}$	6	6	4	3	...	...
		3	2.15	40	$28\frac{1}{2}$	5	5	$3\frac{1}{3}$	$2\frac{1}{2}$	...	...
3	Ocean (Short Voyage)	1	...	...	Increases	Decreases	Increases	Increases	Increases	...	15
		2	1.45	15	$2\frac{1}{2}$	6	6	4	3	...	...
		3	2.15	30	14	5	5	$3\frac{1}{3}$	$2\frac{1}{2}$	...	...
4	Ocean (Long Voyage)	1	...	...	Decreases	Decreases	Increases	Increases	Increases	...	40
		2	7.25	15	13	12	12	8	6	22	49
		3	10.75	30	14	15	15	10	$7\frac{1}{2}$	31	$52\frac{1}{2}$
5	Ocean (Out and Home)	1	...	...	Decreases	Decreases	Increases	Increases	Increases	...	70
		2	1.45	15	19	12	12	8	6	30	91
		3	2.15	20	25	15	15	10	$7\frac{1}{2}$	50	105

The increase in the weight of engines would be found to be about balanced by the decrease in weight of coal required, if the quantity of coal taken was equal to double the gross weight of machinery; the boilers being supposed to remain the same. In these calculations it must be remembered, that the boilers are supposed to remain the same, and the weight of the engines alone are supposed to increase in the ratio of $1\frac{1}{2}$ times the weight for double the size or nominal horse-power, and two times the weight for three times the size or nominal horse-power.

The importance of the gain in cargo-space, may be thus estimated, (taking the Australian vessels as an instance):—

Supposed capital of company,	£ 100	0	0
Working expenses supposed at 65 p. c., with the coals 25. p c.,	65	0	0
To pay 5 per cent. the receipts must be	70	0	0
With engines increased to three times size—			
The capital increased to	130	0	0
Working expenses reduced by saving of 43 per cent., off coals at 25 per cent.,	54	5	0
To pay 5 per cent. the receipts need only be (£54 5 0 × £6 10 0)	60	15	0

But the receipts on former supposition are £70, showing an addition of 7 per cent. on the increased capital, or $9\frac{1}{4}$ per cent. on the original supposed capital.

To this add from $7\frac{1}{2}$ to 15, say 10 per cent. on receipts, extra cargo space, equal to £7.

This gives total receipts,	.	.	.	£ 77	0	0
Working expenses,	.	.	.	54	5	0
Balance for dividend,	.	.	.	£ 22	15	0

This on £130 equals $17\frac{1}{2}$ per cent.

It can be shown also that with *improved machinery*, comparatively no extra capital would be needed, and that no additional space would be required in one engine room, so that a *saving of 43 per cent.* in coal would give $10\frac{3}{4}$ per cent. on capital in the case of Australian vessels, and add besides, from $13\frac{1}{2}$ per cent. to 27 per cent.—say 18 per cent. to the cargo space, and consequently to the receipts—

Thus, capital,	.	.	.	£ 100	0	0
Working expenses reduced to	.	.	.	54	5	0
Receipts as before, £70, to which add 18 per cent. =	£ 12	12	0			
for extra cargo space, making total receipts,	.	.	.	82	12	0
Leaving for dividend,	.	.	.	£ 28	7	0

(To be continued.)

For the Journal of the Franklin Institute.

On the Manner of Steering Steamers; and on Athwartship Bulkheads.

BOARD OF UNDERWRITERS, *New York, Feb. 11, 1856.*

Dear Sir :—In consideration of the peril incurred, and injury sustained by the steamer *Persia* upon her last trip from Liverpool here, I beg leave to renew my suggestion of a previous date, regarding the manner of steering steamers, wherein I recommended that the owners of all steamers be required to have them steered forwards instead of aft, as is customary in our Atlantic Lines, and at the same time to invite your attention to the subject of athwartship bulkheads.

In order to present this subject of steering to you in as brief a manner as practicable, I submit the following summary of the elements of the case, and the advantages of such a change.

When a steamer is steered aft, there is required in addition to the officer of the watch, a second officer to be stationed aft, to communicate orders to the helmsman, the duty of look-outs being confided alone to the forecastle watch, and to the officer of the watch.

When the wheel is placed forward, the number of look-outs is increased by the addition of the second officer of the watch and the helmsman.

When an observation forward renders necessary immediate action with the wheel, the order is given from the forecastle to the officer of the watch; by him it is repeated to the officer of the wheel, and by him to the wheel; this course involving both a delay and ambiguity of interpretation that has in many cases proved fatal.

Regarding the construction and use of athwartship bulkheads, it is unnecessary for me to enter into any details, as the subject is at this time

so fully understood by you. All that is left for me to do, is to suggest that you adopt some course whereby an inducement is held out to the owners of steamers to fit their vessels with them. The example of a resort to them has been set in nearly all of the foreign iron steamers and in two of the New York and Havre Line, and I am gratified in being able to advise you, that upon an interview just had with E. K. Collins, Esq., he promptly declared his intention to have all the steamers of his line forthwith fitted with them.

The frequency of an obscure atmosphere arising from fogs and snow storms, and the presence of icebergs and ice, upon the principal steamer route, viz: between this port and England, and the great numbers of vessels traversing it, added to the character of the entire coast upon both sides, renders this route the most perilous of any open to navigators.

In view, then, of the existing dangers of this route, about to be increased by the addition of no less than five lines of steamers, I am of the opinion that your interests, aside from the dictates of humanity, render it imperative, that prompt action should be taken regarding the change proposed in steering and the adaptation of bulkheads enclosing the vessel into compartments.

I am, respectfully, your obedient servant,

CHARLES H. HASWELL, *Surveyor.*

A. B. NEILSON, Esq.,

President Board of Underwriters, New York.

For the Journal of the Franklin Institute.

On the Polar Open Sea. By T. W. BAKEWELL.

It is generally conceded, that for 8 or 10 degrees of latitude around the north pole, there exists a space clear of ice, "The open Polar Sea."

The doubts as to the fact arise from the apparent anomaly of a relaxation of icy feature, where we might reasonably expect increased rigor.

The following is offered as a contributing cause for this phenomenon:

The existence of an upper current from the pole southward, and a compensating under current, northward, is established beyond dispute.

Now, it will be observed, that in high latitudes, the centrifugal force, by the earth's rotation, acts in the direction (nearly) of a tangent to the surface, or horizontally, and that in the plane of any parallel of latitude, say 85° , the outer edge is driven more forcibly in said horizontal or southward direction, than any point further down the plane. Hence the upper southern flow from the pole, and the under compensating current northwards.

Centrifugal force at the equator is to gravity as $\cdot 003436$ to 1, and is as the cosines of latitude.

That portion of the centrifugal force at any point in the plane of any cosine, which acts horizontally, is as radius to cosine.

The nett value of this force horizontally, after allowing for the small tangential angle is, at the outer edge of the plane $\cdot 000274$ of gravity, and

at 5.8 miles down the plane .000265 of gravity, or a difference of $3\frac{1}{2}$ per cent. But the 5.8 miles down the plane at 85° is only at the moderate depth of one mile (vertically) at $85^{\circ} 5'$.

Cincinnati, February, 1856.

For the Journal of the Franklin Institute.

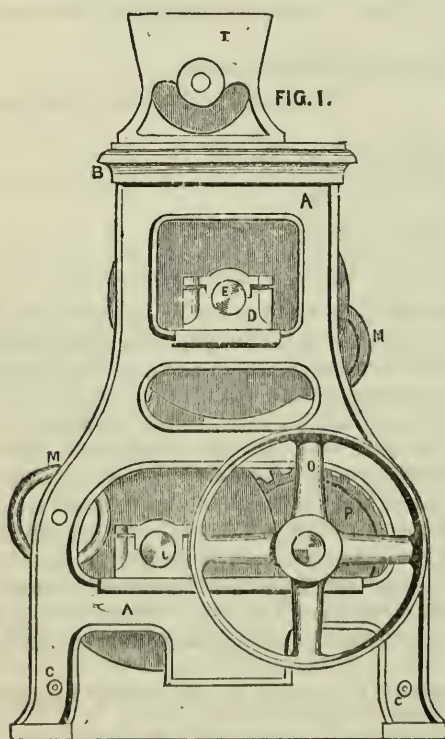
Mechanical Engineering as applied to Farm Implements.

By H. Howson, Civ. Eng.

(Continued from page 190.)

Portable Flouring Mill of Messrs. Weis & Rau, of Bordentown, N. J.; patented by Mr. Joseph Weis, of that place.

This mill has attracted considerable attention on account of its diminutive size and general efficacy, which render it peculiarly well adapted for farm uses.



In reference to the annexed engravings, fig. 1, is an end elevation, showing the exterior of this mill. Fig. 2, a transverse section of the same. Fig. 3, a detached view of the shell and burr.

A A, are the two side frames of the machine which are connected together at the top by the entablature B; and towards the bottom by the cross-stays C.

To each of the frames A, are secured pedestals D, which form the bearings of the shaft E; to this is attached the circular tapering burr F, round which is tightly secured the cast steel covering Q, which may be formed of one piece, or of a series of hoops with their edges in contact with each other. The steel surface of the burr being first turned perfectly smooth, a series of

ordinary coarse file, are cut thereon in disjointed lines obliquely with the axis of the burr.

H, is a semicircular tapering shield of cast iron, having flanches on each side, and notched so as to fit the guides I, which are parallel with

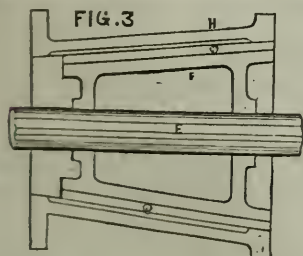
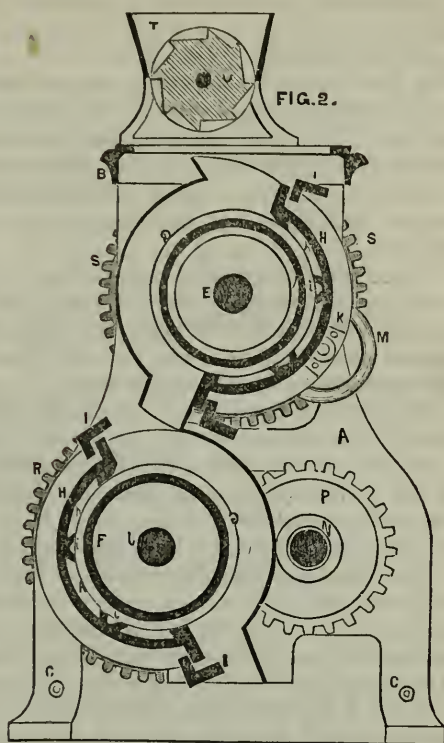
the axis of the burr ; their ends being permanently secured to the inside of the opposite frames.

Three or more steel pieces *h*, are fitted in dove-tailed grooves, cut longitudinally inside the tapering shield *u*, so that their surfaces may assimilate to the circumference of the steel covered burr. Between each of the steel pieces *h*, are two longitudinal grooves *i*, for a purpose hereafter referred to.

The concave surfaces of the steel pieces *h*, have likewise file teeth cut obliquely with the axis of the burr ; the obliquity of the teeth on the burr, and those on the steel pieces *h*, being in contrary direction. Below the shaft *E*, is a second shaft *J*, which has also its bearings on the opposite frames of the machine. On this shaft is a tapering burr with steel covering, similar to that above described, and in proximity with this, is a tapering shield similar to that above referred to, and guided in ways *r*, in a similar manner.

In order to bring the concave surface of the semicircular shield and that of the steel covered burr closer to, or further from, each other, a nut *x*, is attached to the inside of one of the flanges of the shield for the reception of a screw, the end of the latter being connected to the frame *A*, so as to swivel therein without having any lateral movement. These screws are furnished with handle wheels *M*, so that on turning the screws by the same, the shields may be made to slide backwards and forwards on the ways *r*, and their steel pieces consequently be brought nearer to, or further from, the surfaces of the steel covered burrs.

N, is the driving shaft, having also its bearings on pedestals in the opposite frames *A A*. The shaft is furnished with a pulley *o*, on one side of the machine for receiving the driving strap, and has a spur wheel *P*, inside the frames, which gearing into a similar wheel *Q*, on the shaft *J*, causes the latter,



and with it the steel faced burr, to revolve. Outside the machine, the shaft *J*, is furnished with another spur wheel *K*, which gearing into the wheel *S*, on the shaft *F*, causes the upper burr likewise to revolve; so that on turning the pulley *X*, the upper and lower burr have a simultaneous movement imparted to them.

T, is the hopper secured to the top of the frame; and in the lower mouth of the hopper is the roller *U*, on the surface of which are a series of indentations *t*. The feed roller is attached to a shaft which has its bearings on the ends of the hopper, and is furnished with two or more different sized pulleys, round either of which may pass a strap from similar pulleys on the shaft *E*, so that the speed of the feed roller may be altered at pleasure.

The grain to be ground being placed in the hopper and the machine set in motion, the feed roller will turn; and the grain entering the indentations, will pass out in regular quantities into the circumference of the tapered steel covered roller *F*, at the point where the upper portion of the semicircular shield terminates.

The grain is now carried between the shield and the burr, and is acted upon by the oblique teeth on the pieces *h*, and those on the steel covering of the burr, and as these teeth slant in contrary directions, the cutting effect on the grain will be most efficient. This efficiency is increased by the longitudinal grooves *i*, which, as the burr revolves, catch the grain and turn its direction between each of the pieces *h*.

The grain thus partially ground, on leaving the point where the lower portion of the upper shield terminates, drops down a slide into the circumference of the lower burr, where it is again acted upon by the teeth on that burr and those on the shield, and being still further ground thereby, is discharged below into any convenient receptacle.

When it becomes necessary to grind the grain finer or coarser, by turning the wheels *M*, the shields may be brought in closer proximity with, or further from, the burrs, and the desired effect thereby obtained.

In order to prevent the grain from flying, the burrs are covered with guards of sheet iron, or other suitable material. The above mill does not occupy a space of more than 40 inches in height, and 28 inches in width; the burrs being 40 inches long, and 12 inches in diameter, at their largest ends.

(To be Continued.)

For the Journal of the Franklin Institute.

Experiments on Sound for the Application of Ringing Bells.

By JOHN W. NYSTROM.

A body set into vibration, to produce sound, will vibrate a proportionate number of times (per unit of time,) to the pitch of tone produced. Two bodies set into vibration, one twice as fast as the other, will produce what in musical language is called an *octave*, or the relative pitch of the two tones will be, one an *octave* above the other. Two bodies vibrating, one four times as fast as the other, will produce a relative pitch of two *octaves*. In music an *octave* is divided into thirteen parts, and the

number of vibrations per unit of time for each part will be terms in a geometrical progression, of which we know that the thirteenth term is double the first one. For our purpose it is only necessary to assume a certain number of vibrations per second for a given tone, and calculate the proportionate number for each tone within a desired limit. Assume the tone *c*, to make sixteen vibrations per second, the octave above will then make $c = 32$ vibrations in the same time. Now, referring to the formulæ in a geometrical progression in which we know $a = 16$, the first term, $b = 32$, the last or thirteenth term, and $n = 13$, the number of terms.

Required the ratio in the progression?

$$r = \sqrt[n-1]{\frac{b}{a}} = \sqrt[13-1]{\frac{32}{16}} = \sqrt[12]{2},$$

$$\text{or } \log r = \frac{\log 2}{12} = \frac{0.30103}{12} = \log 1.0595 \text{ the ratio.}$$

Let b represent the number of vibrations per second for any tone the order of which from c is n , we shall have

$$b = ar^{n-1} = 16 \times 1.0595^{n-1}, \text{ or}$$

$$\log b = \log 16 + \log 1.0595 (n-1).$$

This is the formula by which the number of vibrations in the following table are calculated.

TABLE I.—Variations per second.

Key Note.	Bass.			Zero.	Descant.			Key Note.
	3d Oct.	2d Oct.	1st Oct.		1st Oct.	2d Oct.	3d Oct.	
C	16.000	32.000	64.000		128.00	256.00	512.00	C
C#	16.947	33.895	67.790		135.58	271.16	542.32	C#
D	17.960	35.920	71.840		143.68	287.63	574.72	D
D#	19.027	38.055	76.110		152.22	304.44	608.88	D#
E	20.159	40.318	80.636		161.27	322.54	645.09	E
F	21.357	42.725	85.430		170.86	341.72	683.44	F
F#	22.627	45.255	90.510		181.02	362.04	724.08	F#
G	23.972	47.945	95.890		191.78	383.56	767.12	G
G#	25.398	50.797	101.590		203.19	406.37	812.75	G#
A	26.908	53.817	107.630		215.27	430.53	861.07	A
A#	28.508	57.017	114.030		228.07	456.13	912.27	A#
B	30.204	60.409	120.820		241.63	483.27	966.54	B
C	32.000	64.000	128.000		256.00	512.00	1024.00	C

First Experiments.—The first experiments were made with brass and cast steel wire, fastened at one end in a bench-vise, and left free with the other end to vibrate when tolled near the vise. A wire thus in vibration will sound, what in musical language is called a *quinta*, or two distinct notes with a relative pitch of five divisions in the octave, as CG, GD, or FC, &c., &c., the table contains the highest note in the *quinta*.

TABLE II.

Cast Steel Wire.				Brass Wire.			
Diameter inches.	Length inches.	Number vibra'ns.	Key Note.	Diameter inches.	Length inches.	Number vibra'ns.	Key Note.
0·131	48	26·91	A	0·14	28	50·80	G#
"	34	57·00	A#	"	24	71·84	D
"	24	120·82	B	"	12	322·50	E
"	17	241·64	B	"	8·5	645·00	E
"	18	203·20	G#	0·096	28	38·05	D#
"	20·37	161·27	E	"	24	50·80	G#
"	21·56	143·68	D	"	12	181·02	F#
"	23	128·00	C	"	9	383·56	G
0·096	40	25·39	G#	0·186	28	64·00	C

The preceding table contains the result of the first experiments, from which I have deduced the following formula for brass wires in which the letters denote,

n =number of vibrations per second of the wire.

d =diameter, and l =length of the vibrating wire in inches.

$$\log n = 0\cdot2 (25 + 4 \log d - 9 \log l).$$

If the wire is made into a spiral, or ring with the ends soldered together, it will sound the same note as the same wire of a similar length when straight.

Second Experiments.—The second experiments were made with a number of *bell metal rings* of different sizes and compositions, cast in green sand at Merrick & Sons' Foundry. Also, two cast iron rings moulded from one pattern and cast one in green, and one in dry sand. The one cast in dry sand was four ounces heavier and sounded half a note sharper than the other.

The section of metal in the annular rings was rectangular; of which the thickness was the difference between the inner and outer radii, and height parallel to the axis of the ring. The diameter of the rings noted in the following table, is the mean of the inner and outer diameters, and measured from the inside of metal to the outside on the opposite side. The different composition of metal has but little effect on the pitch of tone, as from 8 c, 1 t, to 3 c, 1 t, it differs only one note; and for ordinary ringing bells, the composition of metal is generally from 27 to 30 pounds of tin to 100 pounds of copper. I have, therefore, omitted the composition in the following formulæ. The height of the rings has no influence on the pitch of tone, which will be seen in the following table. From these experiments I have deduced a formula by which to calculate the pitch of tone for rings of any size, but of composition from 3 to 4 copper, with one tin. Letters denote,

n =number of vibrations per second. t =thickness; and d =diameter of the ring in inches. $\log n = 0\cdot2 (23\cdot648003 + 4 \log t - 9 \log d).$

TABLE III.—Experiments with Bell Metal Rings.

Composition of Metal.	Weight in ounces.	Height in inches.	Thickness in inches.	Diameter in inches.	Vibrations <i>n</i> .	Key Note.
S C I T	124	1·875	0·4000	10·8125	76·11	D# high.
6 C I T	130	"	"	"	80·63	E
4 C I T	"	"	"	"	83·00	F low.
3 C I T	"	"	"	"	85·43	F
3 C I T	118	1·500	0·3800	11·0000	80·63	E
"	193	1·500	0·7500	10·6250	152·22	D#
"	155	3·000	0·3125	10·7500	82·00	E high.
"	70	1·500	0·2312	10·7500	76·11	D#
"	119	2·875	0·7375	5·7500	228·07	A#
"	115	1·500	0·7500	6·3750	304·44	D#
"	46	1·500	0·4580	3·9370	512·00	C
"	319	2·250	0·6250	13·5620	80·63	E
4 C I T	64	1·625	0·4395	5·7500	215·27	A
Cast Iron.	116	1·875	0·4000	10·8125	95·89	G
"	120	1·875	0·4000	10·8125	101·59	G#

Ringing Bells.—The following formulæ are deduced from about one hundred different bells, of from 10 to 5000 pounds; with the assistance of the preceding experiments. Letters denote

w=weight of the bell in pounds avoirdupois.

D=diameter of the bell at the mouth in inches.

s=thickness of the sound bow in inches.

n=number of vibrations per second, corresponding with the key note of the bell, and to be found in the preceding table I.

k=from 0·07 to 0·08, or a co-efficient expressing the relative thickness of sound bow to the diameter of the bell. In peals of bells, the sound bow is generally *s*=0·08*D* for the triple, and *s*=0·07*D* for the tenor; the intermediate bells in the peal having the intermediate proportions of sound bow. The object of this is to make the *gravity* of tone in the triple approach that in the tenor.

Formulæ for Ringing Bells.

$$w = 0·25 D^2 s \quad (1) \quad D = 2 \sqrt{\frac{w}{s}} \quad (9)$$

$$w = \frac{D^4 n}{232000} \quad (2)$$

$$w = 0·25 D^3 k \quad (3) \quad D = \sqrt[3]{\frac{4w}{k}} \quad (10)$$

$$n = 58000 \frac{s}{D^2} \quad (4) \quad D = 240·83 \sqrt{\frac{s}{n}} \quad (11)$$

$$n = 232000 \frac{w}{D^4} \quad (5) \quad D = 21·947 \sqrt[4]{\frac{w}{n}} \quad (12)$$

$$n = 58000 \frac{k}{D} \quad (6) \quad D = 58000 \frac{k}{n} \quad (13)$$

$$k = \frac{s}{D} \quad (7) \quad s = \frac{n D^2}{58000} \quad (14)$$

$$k = \frac{4w}{D^3} \quad (8) \quad s = \frac{4w}{D^2} \quad (15)$$

$$s = k D \quad (16)$$

Example.—It is required to construct a peal of eight bells in the key of D. Required the diameter, sound bow, and weight of each bell?

Make a table with seven columns like table IV., note down the key notes and number of vibrations for each bell from table I.

The values of k being assumed, calculate the diameters of the bells from formula 13, in which $k=0.07$, and $n=71.84$ for the tenor.

$$D = 58000 \frac{0.07}{71.84} = 56.5 \text{ inches diameter.}$$

Thickness of the sound bow will be found by formula 16, in which $k=0.07$, and $D=56.5$ for the tenor.

$$s = 0.07 \times 56.5 = 3.955 \text{ inches, thickness of sound bow.}$$

Find the weight of the tenor by formula 1, in which $D=56.5$ and $s=3.955$ inches.

$$W = 0.25 \times 56.5^2 \times 3.955 = 3156 \text{ pounds.}$$

These are the dimensions and weight of the tenor; proceed in a similar way with the rest of the bells, and note the results in the table.

TABLE IV.—*Peal of Eight Bells.*

Bells.	Key note.	n	k	S	D	W
Tenor.	D	71.84	0.070	3.95	56.5	3156
2d.	E	80.64	0.071	3.62	51.1	2366
3d.	F $\sharp$	90.51	0.072	3.32	46.1	1765
4th.	G $\sharp$	95.89	0.073	3.22	44.2	1575
5th.	A	107.63	0.075	3.08	40.5	1262
6th.	B	120.82	0.077	2.85	37.0	976
7th.	C $\sharp$	135.58	0.079	2.67	33.8	763
Triple.	D $\sharp$	143.68	0.080	2.58	32.3	673

To Construct a Bell.—When a bell is to be constructed, we generally have the weight or key note given by contract, the diameter and sound bow are calculated by the preceding formulæ and examples, and then ready to proceed with the construction.

The diameter of the bell at the mouth, is divided into 10 equal parts, called strokes, which then is the scale and measurement for the construction. Make a decimal scale, as shown on plate VII.

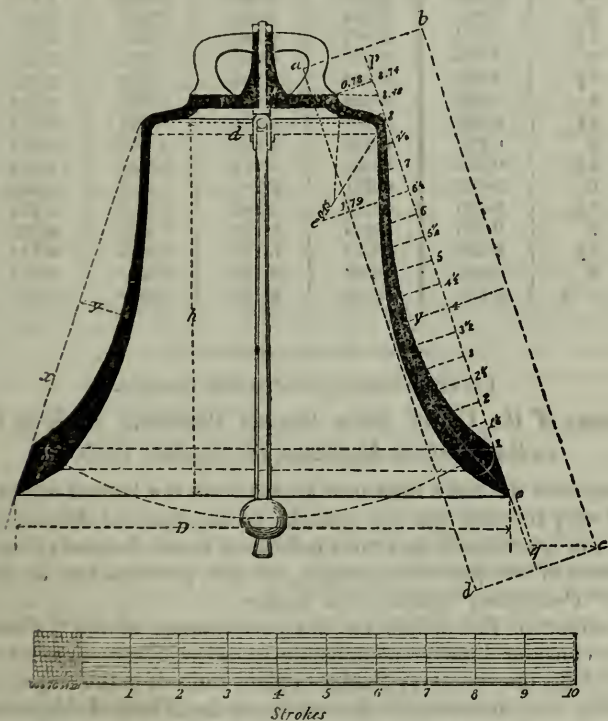
The section of a bell is generally laid out on a piece of board represented by the dotted lines a, b, c, d , which then is cut out and used for turning up the mould for the bell. The board should be about 11 strokes long, and 2.5 strokes wide. Through the centre of the board draw the line p, q , parallel to b, c ,—bisect the line p, q , and set four (4) strokes from the bisecting point towards each end; divide the strokes into halves, and number them as shown on the accompanying drawing. Through each division draw lines at right angles to p, q , set off the corresponding ordinates y expressed in strokes, Table II., and join them by a curve-line, which then will be the centre of thickness of metal in the bell.

In the end of the first ordinate, as a centre, draw a circle with a diameter equal to the desired thickness of the sound bow, which should be

from 0·7 to 0·8 strokes. At every succeeding ordinate draw a circle with a diameter noted in Table V; for instance, if the thickness of the sound bow is $4\frac{1}{2}$ inches, then the thickness of metal or diameter is the circle at the third ordinate will be $4\cdot5 \times 0\cdot474 = 2\cdot133$ inches; but if the sound bow is 0·7, 0·75 or 0·3 strokes, the thickness of metal at the third ordinate will be 0·331, 0·355, or 0·379 strokes. When all the thicknesses are thus drawn, draw the two lines tangential the circles on each side of the centre line of the metal. From the point *o*, draw the tangents to the sound bow; the line *o*·1 should not quite tangent, but leave a moulding about 0·02 strokes, as represented by the drawing. Prolong the $6\frac{1}{2}$ ordinate, and set off 1·79 strokes to *e*, which then is the centre for the curve on the top, draw the arc through the centre of the small circle at the 8th ordinate; join *e*, 8, set off from *e*, 0·46 strokes to the centre for the inside curve at the top.

Thickness of metal of the top should be 0·3 the sound bow at 8, and 0·333 at *r*.

Draw the ordinate at 8·74, set off 0·78 to *r*, join *r* and the abscissa 8·48, and prolong the line through *r*; then finish the drawing as shown on the plate.



When the board is cut out and ready for turning the mould, it must be carefully set, so that the outside diameter of the crown will be half the diameter of the mouth of the bell.

Should the constructor desire to make the bell lower in proportion to the diameter, he can do so by shortening the radius for the top of the crown, or lowering the crown; though not lower than to the seventh ordinate, which only affects the *continuation* of the sound. But whatever height chosen, it is necessary to maintain the diameter of the abscissa at 7.9 strokes, equal to half the diameter of the mouth of the bell, or to maintain the same position of the board to the axis of the bell, in order to attain the *maximum quality of tone*.

Clapper.—The weight of the clapper should be from one-fortieth to one-fiftieth the weight of the bell; the small bells take the largest clapper, and vice versa.

Bell Metal.—Thirty pounds of tin to one hundred pounds of copper is a good proportion.

TABLE V.

Abscissa. x	Ordinate. y	Thickness of Metal.			
		$S=1$	$S=0.07 D$	$S=0.75 D.$	$S=0.08 D.$
1	0.4142	1	0.700	0.750	0.800
1½	0.686	0.800	0.560	0.600	0.640
2	0.867	0.653	0.459	0.490	0.522
2½	0.974	0.547	0.382	0.410	0.437
3	1.025	0.474	0.331	0.355	0.379
3½	1.030	0.423	0.295	0.317	0.338
4	1.000	0.380	0.266	0.285	0.304
4½	0.955	0.351	0.245	0.263	0.281
5	0.875	0.327	0.228	0.245	0.261
5½	0.775	0.301	0.211	0.226	0.241
6	0.665	0.291	0.203	0.218	0.233
6½	0.530	0.286	0.200	0.214	0.228
7	0.390	0.279	0.195	0.209	0.223
7½	0.235	0.272	0.190	0.204	0.217
8	0.075	0.267	0.186	0.200	0.213
9.74	0.78	0.333	0.283	0.250	0.266

For the Journal of the Franklin Institute.

Performance of the United States Steamer Powhatan; Reply to Remarks in the Nautical Magazine, for October, 1855.

Having been for some time past absent from the United States, it was not until very recently that the remarks in the *Nautical Magazine* of October last, in reference to an article published in the *Journal of the Franklin Institute* of the preceding month, on the performance of the U. S. Steamer "*Powhatan*," came to our notice.

The author of the article on the performance of the "*Powhatan*," does not consider himself responsible for misrepresentations or false inferences of any one who may choose to place himself in the august position of a critic; but, inasmuch as the editors of the *Nautical Magazine* have fallen into several grave errors, we take the liberty here of referring to some of them, without having, however, any disposition to enter a lengthy discussion of the subject; for there is no doubt in our own mind that any disinterested person, competent to judge, cannot come to the same

conclusion that the editors of the *Nautical Magazine* have, in reference to the "*Powhatan*."

First, then, they say: "It is this *difference of construction* that has rendered nearly all the past efforts of naval constructors abortive in this country, which engineers seldom think of."

This is certainly very gratifying information, and I have not the slightest doubt but that *engineers* will feel truly thankful for having their attention called to the matter. The inference is obvious: that *engineers* were not before aware why a ship of inferior model could not attain the same speed, with an equal expenditure of power, other things remaining the same, as a ship of superior model! But listen again. They say, "it is the model and disbursement of materials, which make the *difference of construction*, growing out of a mistaken notion of the laws of resistance." Now, we would like to inquire if "the model and disbursement of materials" did not make a difference in the construction of a ship, what would? But, it does not appear quite so conclusive to our mind, that "the model and disbursement of materials" of a man of war, are occasioned by a "a mistaken notion of the laws of resistance." A mere *ipse dixit* on this point does not strike us to be very good evidence. We do not pretend to say, however, that the model of the "*Powhatan*" could not be improved, but until we meet with a war steamer that is capable of attaining the same speed that the "*Powhatan*" has attained, and is as strongly built, we are willing to take her for sea-going purposes, notwithstanding the abortive efforts of naval constructors in this country. The truth is, too much is expected of the steamers of the navy. They are expected to be swift steamers, fast sailers; to consume much less coal than is required for a merchant steamer of the same size; to carry a large armament and sufficient coal for long voyages; to outrun all merchant vessels they meet; to never have any accidents to occur to their machinery. In other words, to perform miracles; and if they fail in any one of these particulars, they are in consequence denominated abortions.

Again, we quote. They say "we have a new feature presented by this writer—he would call attention to the *masts, spars, &c.*, as disqualifying the vessel from acquiring the same facility of movement that a merchant vessel would acquire."

Such was certainly the intention of the writer, and he has no reason, from any thing that has subsequently come to his notice, to change his mind. We suppose the editors of the *Nautical Magazine* are aware, that the time sail can be set on a side wheel steamer at sea, compared with her total running time, is very small, and that, when going head to wind, the resistance of the masts, spars, rigging, etc., necessarily prevent her from attaining the same speed, every thing else remaining unaltered, that she would attain without them. This resistance is considered in the merchant service more than sufficient to counterbalance any advantage desirable from the sails in case of fair winds; for which reason the masts and spars are reduced to a minimum for safety, should the machinery become disabled.

Once more. Referring to the average speed of 10 63 knots the hour, they say, "it is plain to every *practical mind*, that this vessel has done her best in a smooth sea and with a fair wind, and that she has due credit for it."

In referring to the abstract log, we remark that the sea was *not* smooth, but that it was light during the first day, and for the remainder of the time it was moderate. Leaving this, however, out of the question, we cannot see *why* it is plain to every *practical mind*, that this vessel did her best. If a little more information had been given in the *Nautical Magazine*, and fewer assertions, it strikes us that it might have been followed by beneficial results, even to the *practical mind*.

We take it upon ourselves to say that our convictions are not in accordance with those of the Editors of the *Nautical Magazine*, and that this vessel did *not* do her best. Our reasons for asserting this are the following:—

It must be manifest to any one, that when a steamer like the "*Powhatan*" does her best, it must be under the most favorable circumstances of wind and sea, with all the sail set she is capable of carrying, and the engines worked up to their maximum power. Such was not the case with the "*Powhatan*;" for the quantity of coal allowed to be consumed per day in the boilers of the steamers belonging to the navy, is regulated by the captain, and he accordingly directs more or less to be burned, as he desires the speed of the ship to be increased or diminished; taking advantage always of fair winds to reduce the coal to a minimum, unless there be an object to make a passage within a certain time. In the case in question, the quantity of coal consumed was 45.59 tons per day, of so inferior quality that it gave an evaporation of only 4.07 lbs. of water per pound of coal. Now, as the boilers of the "*Powhatan*," as stated in the article on her performance, evaporate $2\frac{1}{2}$ lbs. more water than this, per pound of coal, it follows that had the coal been of a good quality an equal amount of power would have been secured by the consumption of 28.24 tons of coal per day.

We see that the resistance of the ship was reduced to such an extent by the sails, *i. e.*, the engines were relieved to such an extent that this amount of coal propelled her at the rate of 10.63 knots per hour. Now, then, inasmuch as the wind was on the quarter, increasing the speed of the ship from 10.63 knots to 12.8 knots could not sensibly reduce its effect on the sails; and assuming the power to increase as the cube of the velocity, without going into any minute calculations, we have

$$10.63^3 : 12.8^3 :: 28.24 : 49.3,$$

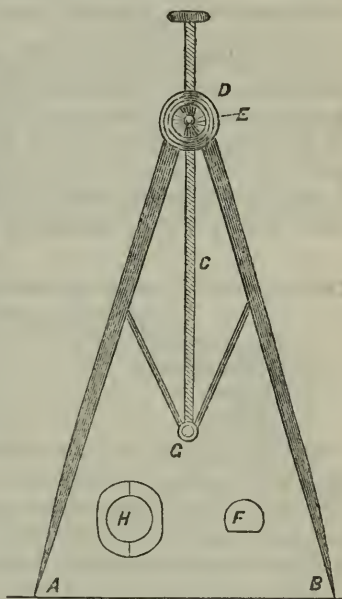
the number of tons of coal required to propel her at the rate of 12.8 knots per hour with the sails set, as in the case under consideration. The boilers of the "*Powhatan*" are capable of, and have consumed coal at the rate of 75 tons per day, (for the truth of which we respectfully refer the skeptical to her log books.) If she had consumed this amount of coal in the above case, the power would have been increased 52.3 per cent. over what would have been required to propel her at the rate of 12.8 knots, which we fancy will be conceded by any disinterested person to be quite sufficient to balance any assistance derivable from the small amount of sail set. Hence we have no hesitation in repeating, that with an unlimited supply of good coal, with a mean draft of 17 feet 9 inches, in smooth water, she is capable of attaining a speed of 12.8 knots the hour without the assistance of sails.

The advice given in the conclusion of the remarks in the *Nautical Magazine*, we consider entirely gratuitous. Had we deemed it necessary for the elucidation of the subject, the resistance of the ship could have been obtained without the advice of any one. We beg leave also to say, that if the Editors of the *Nautical Magazine* choose to give credit to any ship for having moved faster than the instrument that is propelling her, it is no fault of ours, but it occurs to us that it reflects no very great credit on those who chronicled such an occurrence. K.

Description of Gover's Indicating Compasses.*

The following description of an improvement in compasses has been forwarded to us by the designer, Mr. H. C. Gover, of London.

"The principle of these compasses is at once seen on reference to the engraving. The points of the compasses, A, B, are extended or contracted by means of a screw c, which works through a box d,* and the nut e. The screw is filed flat on one side, as shown at f, and on the flat surface, is marked an index, which at the point d, indicates the distance between the points A B. The screw is attached to the levers at their juncture g, by a swivel, so as to permit them to work round. The legs of the compasses are hollowed out, as shown at h, so that they shut quite close. As the points of the compasses are liable to become sensibly diminished by wear in the course of time, the top-piece d, may be made to screw tightly on, and be from time to time re-adjusted to the index."



* This has been accidentally omitted in the engraving; the letter d, indicates its position.—ED. M. M.

For the Journal of the Franklin Institute.

On Gas Furnaces. By CHARLES SCHINZ.

The intensity or temperature of a fire, depends partly on the composition of the fuel burned, but still more on the quantity of air used for the combustion.

* From the Lond. Mechan. Mag., November, 1855.

To illustrate this, and to estimate the exact amount of the quantity of heat as well as intensity for different fuels, we give the following tables:

TABLE I.

Composition of different kinds of fuel and quantity of heat produced by each of them.

	Composition.			Produces units of heat.		Total units of heat produced.
	Ashes Water and Nitrogen.	Carbon.	Free Hydrogen.	(1 lb. Carbon yielding 14,500 units of heat.)	(1 lb. Hydrogen yielding 62,000 units of heat.)	
Seasoned wood,	0.600	0.394	0.007	5713	434	6147.
Bituminous coal,	0.150	0.815	0.035	11817	2170	13987.
Charcoal,	0.070	0.930		13485		13485.
Coke,	0.150	0.850		12325		12325.
Anthracite,	0.061	0.915	0.0244	13267	1513	14780.

These quantities of heat are produced invariably if all the carbon be burnt into carbonic acid, but if there is a deficiency of oxygen, the carbon produces another compound, which is known under the name of oxide of carbon; and since 1 lb. of carbon furnishes only 2442 units of heat, while 14,500 units of heat are produced if it is burned to carbonic acid, it is evident that the quantity of heat produced from the fuel is diminished in proportion to the quantity of oxide of carbon formed.

TABLE II.

The heat produced from the different kinds of fuel mentioned above, the carbon being burnt only to oxide of carbon, is as follows:

Seasoned wood,	.	.	1397 units of heat.
Bituminous coal,	.	.	4160 "
Charcoal,	.	.	2271 "
Coke,	.	.	2075 "
Anthracite,	.	.	3747 "

The loss of heat is therefore for each kind of fuel respectively: 77, 70, 83, and 75 per cent.

Though Table II represents the extreme case in which no carbonic acid is formed, and which never occurs in practice, yet it shows that the production of any carbonic oxide is attended by a very serious loss.

The composition of the fuel being known, it is easy to calculate the exact quantities of air required for its combustion; 6 parts of carbon require 8 parts of oxygen to form oxide of carbon, 16 parts of oxygen to form carbonic acid; and 1 part of hydrogen requires 8 parts of oxygen to form water.

In the following table, we give these calculations for the two cases, viz: for the combustion to oxide and to acid of carbon.

TABLE III.

Air required for the combustion of 1 lb. of different fuels.

	For perfect combustion.	For imperfect combustion.
Seasoned wood,	60.3 cubic feet.	31.6 cubic feet.
Bituminous coal,	133.7 "	85.8 "
Charcoal,	135.1 "	62.9 "
Coke,	123.5 "	61.7 "
Anthracite,	143.6 "	77.1 "

These calculations, however, though theoretically correct, are not practically so, for the following reasons:—

When the fuel lies on the grate in a thin stratum and a large draft of air is supplied, all the carbon contained in the fuel is burned to carbonic acid, but the excess of air that goes through the fuel, causes a loss of heat; and even in the best constructed furnaces, this excess is twice as much as the quantities given in the table.

If the stratum of the fuel is made thick, little or no air escapes unburnt, but in such case it is impossible to avoid the formation of oxide of carbon which escapes combustion, and hence, as made apparent in Table II, an immense loss of the heat is the result.

Notwithstanding the heavy losses thus sustained, thick strata of fuel are made in all cases, where intensity of heat is desirable, and we are going to show now how far this is explained by theory.

A unit of heat is so much heat as is required to raise the temperature of 1 lb. of water one degree Fahrenheit. To raise the temperature of 1 lb. of air one degree, requires less heat, only 0.2377 of that required for 1 lb. of water, and this number is therefore termed the specific heat of air. From this specific heat we may calculate the heat required for a certain volume of air. For one cubic foot of air it is 0.018575, and this we term the capacity for heat of air.

In the following table, we give the specific heat, and the capacity of heat for such gases as we have here to deal with.

TABLE IV.

Specific heat and capacity of heat for different gases.

Atmospheric air,	Specific heat,	0.2377	Capacity of heat	0.018575
Nitrogen gas,	"	0.2440	"	0.018839
Carbonic acid gas,	"	0.2164	"	0.026858
Carbonic oxide gas,	"	0.2479	"	0.019133
Water in the form of vapor,	"	0.4750	"	0.023534

With these figures, which are the result of the most exact and careful experiments, we are enabled to calculate the temperature of any fire, provided we know the composition and the quantity of fuel burnt, and the quantity and quality of the products resulting from that combustion.

It is now apparent, that the temperature of a fire must vary very much, even in one and the same furnace; yet we may distinguish three general cases, viz:—

1st. A perfect combustion with the strictly required quantity of air.

2d. A perfect combustion with twice as much air as is required, which we may consider in practice to be the case, where fires have a good draft and the strata of fuel are thin.

3d. An imperfect combustion, where a part of the fuel (which we may call one-half) escapes, as oxide of carbon.

The following table gives the products of combustion for these three cases.

TABLE V.

	Perfect Combustion.							Carbon-ic oxide.	Carbon-ic acid.	Steam	Nitro-gen gas.
	Without excess of air.			With excess of air.							
	Carbon-ic acid.	Steam.	Nitro-gen gas.	Carbon-ic acid.	Steam.	Nitro-gen gas.	Excess of air.				
Seasoned wood, lbs.	1.445	0.663	3.706	1.445	0.663	3.706	4.811	6.460	0.722	0.663	2.779
Bituminous coal, lbs.	2.899	0.315	8.212	2.899	0.315	8.212	10.667	0.963	1.449	6.315	6.159
Charcoal, "	3.410	0	8.300	3.410		8.300	10.819	1.085	1.705		6.225
Coke, "	3.116	0	7.586	3.116		7.586	9.885	0.991	1.558		5.697
Anthracite.	3.355	0.219	8.821	3.355	0.219	8.821	11.680	1.067	1.677	0.219	6.615

Multiply now these quantities of gas by the specific heat of each, and we obtain their specific heats as produced from 1 lb. of fuel.

Table VI, gives the results.

TABLE VI.

Specific heat of the gases produced in the combustion of the different fuels.

	Perfect Combustion.		Imperfect combustion.
	Without excess of air.	With excess of air.	
Seasoned wood,	1.532	2.652	1.279
Bituminous coal,	2.781	5.265	2.206
Charcoal,	2.763	5.282	2.156
Coke,	2.525	4.826	1.972
Anthracite,	2.982	5.701	2.346

If we divide now the quantity of heat produced by the fuel as set down in Table I by these figures, we obtain Table VII, showing the temperature of the fire under the aforementioned three circumstances, viz:—

1st. When the air is the exact amount required.

2d. When it is double as much.

3d. When (as we supposed,) one-half of the carbon passes off as oxide of carbon; (the quantity of heat produced by the fuel being then one-half of the quantities noted in Table I, and one-half of the numbers noted in Table II.)

TABLE VII.

Temperatures attained by the different kinds of fuel, under different circumstances.

	Perfect Combustion.		Imperfect combustion.
	Without excess of air.	With excess of air.	
Well seasoned wood,	4120° Fah.	2318° Fah.	2949° Fah.
Bituminous coal,	5029° "	2653° "	4113° "
Charcoal,	4881° "	2553° "	3770° "
Coke,	4881° "	2554° "	3651° "
Anthracite,	4956° "	2592° "	3949° "

These results are highly important, and can be fully relied upon as long as the conditions on which they are founded, are observed in practice.

Now, the results represented by the first column, are purely theoretic-

cal, and show what may be obtained if the theoretical requirements are satisfied.

The results of the second column are those of practical observation, controlled by the chemical analysis of the gases produced in the combustion.

The results of the third column are, of course, merely imaginary, since a thick layer of fuel may, according to the size of the pieces, the draft, and divers other circumstances, produce more or less heat, and at the same time allow some of the air to escape undecomposed. They are, however, the most favorable that can be obtained under any circumstances, even if the air is introduced by means of a blower.

The figures in the third column, show, likewise, the truth of our previous statement; that in cases where intense heat is required, thick strata of fuel are always made, even though the loss caused by the formation and non-combustion of oxide of carbon is considerable.

In scientific language the cases represented in the 2d and 3d columns come under the head of extensive and intensive firing.

Extensive firing is applied in all cases where the body to be heated requires but a low temperature, as the heating of our dwellings, of steam boilers, and the like; whereas, intensive firing is required in many of the arts, and particularly in metallurgy.

From what precedes, it is evident, that intensive firing is invariably attended with a loss of 40 per cent.; it is therefore used only in such cases, where intensity of heat is required by the nature of the operation.

It is by no means asserted, that there is no loss in extensive firing. It is well known that more heat passes up the chimney than is necessary to produce the draft.

The draft of a chimney involves much greater complication than most persons suppose.

It is not a simple process. The power of the draft is by no means a constant one. It is affected by many causes; for instance, by the state of the atmosphere, by the heat taken up by the chimney, by the greater or lesser absorption of the heat before the gases reach the chimney, and chiefly by the variable quantity of fuel burnt in a given time.

The quantity of power required, is also variable, it being absorbed by the friction the gases undergo, in passing, 1st, through the fuel, 2d, through the flues, and 3d, through the chimney. Now, this friction increases with the square of the velocity of the gases, and the velocity of course increases as well with the quantity of fuel burnt as with the expansion of the gases themselves; so that it is scarcely possible to control the quantity of air supplied by mere calculation, and this quantity must vary almost at every moment.

The draft, however, aside from the causes of irregularity, depends principally upon, 1st, the size of the pieces of fuel, and 2d, the thickness of the stratum on the grate.

To remedy the first cause, the fuel is screened and otherwise prepared so as to render the size of the pieces as uniform as possible, and to remedy the second, has been a subject for study to many inventors. Numerous contrivances have been proposed, but not one sufficiently simple to be adopted. In most of these inventions it was proposed to distribute the fuel continuously on the grate by mechanical means, but the mechanism was

always found to be so complicated as to require too much power, as to be of no practical benefit.

A blast used to furnish a draft, is an improvement upon the chimney. It gives a more constant supply of air, and hence allows the better application and more complete use of the heat; but it does not remedy the inconvenience arising from the variation in the size of the strata of fuel, and these, as we have seen, are not only a change in the quality of the gases of combustion and consequently in the quantity of heat produced, but also the absorption of a variable quantity of the power that supplies the air.

From what we have written we may draw the following conclusions:

1st. The supply of the air to the fuel, is not only cheaper if affected by mechanical means, but also a correction of many of the defects of the power produced by a chimney.

2d. The careful preparation of the fuel, though to a certain degree expensive, is not to be dispensed with, if economy of heat would be attained.

3d. The irregularities in the size of the fuel, is a practical difficulty not yet successfully overcome.

4th. Partly from the later cause, and partly from others hereafter described, the heat theoretically producible from a quantity of fuel, has hitherto never been obtained.

(To be Continued.)

For the Journal of the Franklin Institute.

Trial Trip of the United States Steam Frigate Merrimac.

The recent successful trial trip of this vessel of a week at sea, is of more than usual importance, from the fact that she is the first of five vessels (almost identical in size, and having the same power and armament), now building by the Navy Department, all of which will be in service during the year 1856. The sixth vessel, the *Niagara*, building in New York, is so entirely different from the others, that she will merit a special notice when finished. But to return to the *Merrimac*. She left Boston Harbor, on Monday, the 25th of February, and entered the Chesapeake on Monday, March 3d; having been under full steam all the time, during which she consumed 224 tons of anthracite coal. She has two distinct back action engines, with cylinders 72 inches diameter, 3 feet stroke; each cylinder is placed near to the crank shaft, allowing sufficient room for the crank to turn, and the piston has two rods, which pass beyond the shaft to a cross head, which, at half-stroke, is $7\frac{1}{2}$ feet distant, and from which the connecting rod leads back to the crank shaft, being somewhat similar to those of the English Steamer *Amphion*. There are four boilers known as Martin's Patent, having been arranged and patented by Daniel B. Martin, Esq., Eng. in Chief, U. S. Navy, each being 14 feet wide in front, 11 feet 3 inches long, and 14 feet 3 inches high; each boiler has 4 furnaces below, the arches continuing to the up-take, where the products of combustion return to the front of boiler, between a series of brass vertical tubes, 3 feet 3 inches long, 2 inches exterior diameter,

with a clear space between them of $\frac{7}{8}$ of an inch. All four boilers unite at one smoke pipe, which is 8 feet diameter in the clear, and about 70 feet high when hoisted up. The boilers are placed at each side in the vessel, facing the centre, having one fire room 9 feet wide, between which, is common to all.

The total fire surface is, ...	11,500 sq. feet.
And of grate surface, ...	330 " "
Weight of water in boilers, ...	85 tons.

Attached to the steam department, is a pair of small engines for hoisting coal on board, and 2 steam pumps of large size, arranged for pumping out ship, feeding and pumping out boilers, and for fire. These engines have an auxiliary boiler to supply them with steam when necessary. Her bunks will hold 600 tons of coal. The position of the engines is forward of the mainmast, and about 125 feet from the stern post. The propeller is on Griffith's patent, (in this respect differing from all the other vessels, as they have propellers of the usual form,) 17 feet 4 inches diameter, having 2 blades, and weighing about 19,000 lbs.; it is arranged to hoist out, and may be raised from its position with great facility.

Fig. 1, shows two views of one blade of the propeller, the full lines showing the area viewed from the stern, and the dotted lines showing the area viewed at right angles to face of blade.

Fig. 1.

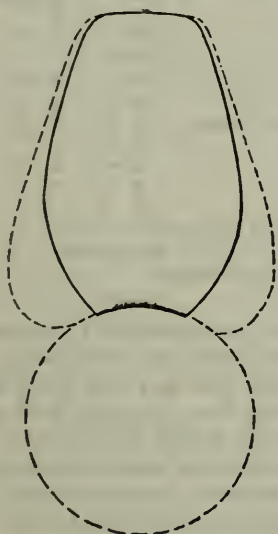
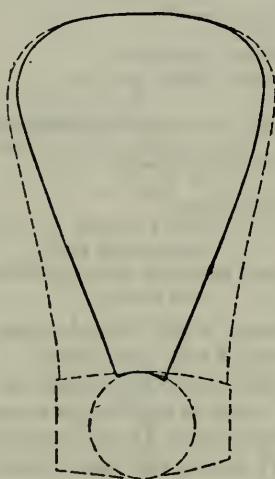


Fig. 2.



Scale $\frac{1}{4}$ -inch=1 foot.

Fig. 2, shows two similar views of one blade of the propeller for the steamer *Wabash*, building by Merrick & Sons, of this city, being a sister ship to the *Merrimac*, and now very near completion.

Fig. 1, is constructed as a true screw at 17 feet pitch, with an arrangement for altering the pitch of the blades. On the trial trip, the blades were set at a pitch of $29\frac{1}{2}$ feet at their periphery, which gave $25\frac{5}{12}$ feet

at the hub, and $26\frac{2}{3}$ feet at centre, between hub and periphery. Mean effective pitch, 25 feet $9\frac{1}{2}$ inches. The hub is a sphere 5 feet diameter.

Fig. 2, is constructed as a true screw of 23 feet pitch. The full area of one blade of fig. 1, is $29\frac{1}{2}$ feet, and of fig. 2=38 feet.

On trial trip, the greatest speed under steam made, was going out of Boston Harbor; water, smooth; wind, fair; tide, slack water; average revolutions at the time, 41; when a speed of $9\frac{1}{2}$ knots an hour was obtained. Under similar circumstances, against the wind, the speed was $7\frac{1}{2}$ knots. As the speed of the propeller was uniform, the slip in one case, was 10 per cent., and in the other case, 28 per cent.

As this trip was for the particular purpose of testing her machinery, and was of limited duration, no opportunity occurred for obtaining the best speed under canvass and steam; but her officers have no doubt of her ability to make 15 knots.

Her machinery was constructed by Robert P. Parrott, Esq., lessee of the West Point Foundry, New York.

The hull of the *Merrimac* is built in the best manner, and of the best material, from the designs and model of John Lenthall, Esq., Chief of the Bureau of Construction; her dimensions are as follows:

Length over all,	300 feet.	
“ from knight-head to taffrail,	281 “	
“ from stern post forward of propeller stem at 23 feet draft,	257 “	9 inches.
Extreme breadth,	51 “	4 “
Moulded “	50 “	2 “
Breadth at spar deck,	46 “	
Depth of hold to spar deck,	33 “	8 “
“ “ “ gun “	26 “	3 “
Height between berth and gun deck, clear of beams,	5 “	9 “
“ between gun and spar deck,	6 “	
Depth of keel forward,	1 “	9 “
“ “ aft,	2 “	3 “
Deep load line,	23 “	
Area of immersed midship cross section, at 23 feet draft, inclusive of keel,	876 sq. feet.	
Length amidships below berth deck devoted to engines and boilers,	60 feet.	

Her frame is of live oak, sided 13 ins., and moulded 17 ins. at the centre, and 14 ins. at the sides. The floor is solid for its whole length; and the frame is cross strapped on the inside, with iron bars $4\frac{1}{2} \times \frac{3}{4}$ crossing each other at right angles, and running from the spar deck to the turn of the bilge. These plates or straps are bolted at each frame, and where they cross each other, with $1\frac{1}{4}$ in. bolts; she is also plated outside at stem and stern, with iron bars of the same size; distance through dead wood at shaft, 20 feet. The after cants are fitted together as high as the berth deck, and bolted edgways. Garboard strakes, 10 ins. thick, and bolted through from side to side, making the seats of floor 4 feet wide. The bottom plank are of white oak 5 ins. thick, and the wales are 7 ins. thick. The berth deck beams are of yellow pine and side 16 ins.; this deck has 7 strakes of clamps 12 ins. wide and 7 ins. thick. The gun deck beams are of yellow pine, sided 17 ins., and moulded 14 ins. The space between the berth and gun decks, is filled at the sides with oak clamps 7 ins. thick; the planks of this deck are 5 ins. thick. There are

38 ports on this deck, and the port sills are 20 ins. deep. The spar deck beams are sided 17 ins., and moulded 13 ins.; deck plank 4 ins. thick; under side of rail 3 feet 8 ins. above deck. Top of hammock rail 5 feet 8 ins., and top of hammocks when stowed, 7 feet 8 ins. above deck. The hull is fastened entirely with copper bolts below, and 1 ft. above deep load line; above that with iron. There has been driven into her hull, 226,740 lbs. of iron, and 139,778 lbs. of copper bolts, from $1\frac{1}{2}$ to $\frac{3}{4}$ -inch diameter. The spar deck is flush, having no obstruction for its length and width, except hatches and smoke pipe. On the gun deck there is the captain's cabin, 30 feet long from the stern, and the galley. On the berth deck aft is the ward room; and then the rooms for the accommodation of the several grades of officers. Forward of these rooms, at each side, is a coal bunk of moderate size, and the balance of the space on this deck is devoted to the crew. On the after orlop deck, are the cockpits; two large bread rooms; 2 sail rooms; 2 store rooms; and 2 state rooms for the use of captain's, and purser's clerks. The forward orlop deck has the general store room; 2 sail rooms, and 2 bread rooms.

She has a round overhanging stern, with quarter galleries, and has the general appearance of a first class man-of-war, without that heavy appearance that has been supposed to belong to vessels of that class.

SPARS.—	LENGTHS.	ft. in.		DIAMETERS.	ft. in.
Main mast,	.	106 5	at deck,	.	3 6
“ topmast,	.	78 10	greatest,	.	1 9
“ top gallant mast,	.	34	“	.	1 0 $\frac{1}{4}$
“ royal mast, 23; Pole 10 10, 33	10				
From spar deck to main truck,	222	2			
Main yard,	.	110 4	at slings,	.	2 1 $\frac{1}{2}$
“ top sail yard,	.	83 4	greatest,	.	1 8 $\frac{1}{2}$
“ top gallant yard,	.	52 3	“	.	10 $\frac{1}{4}$
“ royal yard,	.	35	“	.	7
Fore mast,	.	96 11	“	.	3 2
“ topmast,	.	72 6	“	.	1 9
“ topgallant mast,	.	31 3	“	.	1 0 $\frac{1}{4}$
“ royal mast, 21 3; Pole, 5,	26 3				
From spar deck to fore-truck,	198	9			
Fore yard,	.	99 4	“	.	1 11 $\frac{1}{4}$
“ topsail yard,	.	75	“	.	1 6 $\frac{1}{2}$
“ topgallant yard,	.	47	“	.	9 $\frac{3}{8}$
“ royal yard,	.	31 6	“	.	6 $\frac{1}{2}$
Mizen mast,	.	80 8	“	.	28
“ topmast,	.	59 3	“	.	1 3
“ topgallant mast,	.	25 6	“	.	9
“ royal mast, 17 4; Pole, 4,	21 4				
From spar deck to mizen truck,	170	6			
Cross jack yard,	.	81	“	.	1 5 $\frac{1}{2}$
Mizen topsail yard,	.	61	“	.	1 3
“ topgallant yard,	.	38 2	“	.	7 $\frac{1}{2}$
“ royal yard,	.	25 6	“	.	5
Spanker boom,	.	60	“	.	1 1
Gaff,	.	46	“	.	8 $\frac{1}{2}$
Bowsprit, outboard,	.	36	“	.	3 2
Jibboom,	.	27	“	.	1 5
Flying jibboom,	.	23 3	“	.	10 $\frac{1}{2}$

The foremast steps on the keelson in the usual way; but as the main-mast comes directly above the screw-shaft, it steps on a solid live oak cross beam, about 10 feet from floor, 3 feet wide, and 15 inches deep,

which is supported from below by two wrought iron columns, 10 inches diameter, rising at each side of shaft. The mizenmast is stepped on the after orlop deck.

SAILS.—		sq. ft.		sq. ft.
Fore sail,	.	4026	Lower studding-sails,	each 2856
" topsail,	.	3692	Fore-topmast studding sails,	" 1970
" topgallant-sail,	.	1488	Main-topmast " " "	" 2190
" royal,	.	693	Fore-topgallant " " "	" 924
Main sail,	.	5125	Main " " " "	" 918
" topsail,	.	4560	Jib,	2425
" topgallant-sail,	.	1815	Flying jib,	1780
" royal,	.	815	Fore-spencer,	2193
Spanker,	.	2185	Main " "	2166
Mizen topsail,	.	2436	All storm-sails,	3785
" topgallant,	.	975		
" royal,	.	459		

One suit of sails will cover an area of 58,372 square feet.

Armament.—On spar deck two 10 in. pivot guns, 87 cwt. each, one forward and the other aft; also fourteen 8 inch broadside guns, 63 cwt. each; on gun deck, twenty-four 9 inch broadside guns, 67 cwt. each. Total weight of forty guns, 133 tons, exclusive of carriages. They are all intended for hollow shot and shells.

Her crew will consist of 600 men, exclusive of officers. On the trial trip she easily made under steam and sail, 15 knots per hour, and $9\frac{1}{2}$ knots under steam alone in smooth water, having a full complement of men, stores, &c., on board, and 600 tons of coal. When it is considered that this vessel is 700 tons larger than any of the Collins' steamers, is 6 feet wider, and draws 2 feet more water, and that she has but a little more than half the power, her performance is one with which the Navy Department may well be pleased. B.

*New Ornamental Castings.**

Works for the prosecution of an entirely new branch of industry have been opened by Mr. Chance, about five miles from Birmingham—the manufacture of architectural decorations and adjuncts in basalt. The ragstone of the neighborhood is melted and cast in hot moulds, and cornices, doorheads, and other architectural enrichments are produced, of very lasting quality. When cast in cold moulds, a glassy lava, known as obsidian, is produced—an interesting fact in a geological point of view.—*Builder.*

In support of the probability of an extension of this new branch of industry, we may mention that operations are now going on at Ordnance Wharf, Rotherhithe (the works of the Colonial Gold Company), where furnaces have been erected for the reduction of gold quartz by direct fusion, under the patent of Mr. Charles Low, late of Swansea. The quartz thus treated is first crushed moderately small, then calcined or roasted, and afterwards fused with a mixture of fluorspar, lime, and oxide of iron, which liquefying agents combine with the silica, and render the matrix perfectly fluid. The primary object is to liberate the gold found by analysis to exist in the quartz, the particles depositing in a bed, or

From the Lond. Mech. Mag., Jan., 1856.

bath, of molten lead at the bottom of the furnace; but the fused mass run off as refuse is capable of being cast into iron moulds, and will form ornamental bricks, or blocks of stone, of lasting quality and great beauty, which practical use of the refuse will materially lessen the cost of the manipulation. The metallic alloy at the bottom of the furnace is to be subjected to direct cupellation for the gold produce, the result of which, as an experiment, is watched with considerable interest by scientific men.

For the Journal of the Franklin Institute.

Particulars of the Steamer Canadian.

Hull built by Wm. Denny & Brothers. Machinery by Tilloch & Denny, Dumberton, Scotland. Intended service, Liverpool to Montreal.

HULL.—

Length on deck, from fore part of stem to after part of stern post, above the spar deck, ...	277 feet 2 inches.
Breadth of beam at midship section, ...	35 "
Depth of hold, ...	23 "
" " to spar deck, ...	30 "
Draft of water at load line, ...	18 "
Tonnage, $\left\{ \begin{array}{l} \text{engine room,} \\ \text{hull,} \end{array} \right. \begin{array}{l} 719 \\ 1045 \end{array} \right\}$	1764.
Contents of bunkers in tons of coal, ...	700:
Masts and rig, ...	Barque.

ENGINES.—Vertical direct.

Diameter of cylinders, ...	62 inches.
Length of stroke, ...	3 feet 6 "
Maximum pressure of steam in pounds, ...	12.
Cut-off, ...	None.
Maximum revolutions per minute, ...	46.

BOILERS.—Two—Horizontal Tubular—fired at both ends.

Length of boilers, ...	18 feet 10 inches.
Breadth "	9 " 9 "
Height " exclusive of steam chimney, ...	14 " 3 "
Number of furnaces, ...	3 in each end of each boiler.
Breadth of "	2 " 7 "
Length of grate bars, ...	6 " 6 "
Number of tubes, ...	366 in each boiler.
Internal diameter of tubes, ...	3½ "
Length of tubes, ...	6 " 6 "
Diameter of smoke pipes, ...	4 " 10 "
Height " "	48 "
Description of coal, ...	Bituminous.
Combustion, ...	Natural draft.
Consumption of coal per hour, ...	30 tons.

PROPELLER.—

Diameter of screw, ...	16 feet.
Length of blades, ...	5 " 8 inches.
Pitch of screw, ...	25 "
Number of blades, ...	2.

Remarks.—Frame of wrought iron plates, 16 courses 1 to $\frac{7}{16}$ ths thick. Floors (Z) moulded 6, sided $\frac{1}{2}$ by $3\frac{5}{8}$ flanch. Distance of frames apart at centres 12 and 15. Floors are 27 inches deep over keel. Rivets $\frac{3}{4}$, and $\frac{7}{8}$, and 4 ins. apart. Double and abut riveted. Has 2 side keelsons $7\frac{1}{2}$ ins. deep by $1\frac{5}{8}$ thick, 1 flanches 6 ins.

C. H. H.

Hull built by I. Simonsen. Machinery by Allaire Works, New York.
Intended service, New York to Liverpool.

Length on deck, from fore part of stem to after part of stern post above the spar deck, ...	331 feet.
Breadth of beam at midship section, (moulded,)	47 " 6 inches.
Depth of hold, ...	24 " 6 "
" " to spar deck, ...	32 " 6 "
Length of engine and boiler space, ...	114 "
Draft of water at load line, ...	19 "
Tonnage (carpenter's), ...	5000.
Contents of bunkers in tons of coal, ...	1200.
Masts and rig—topsail schooner.	

Diameter of cylinders, ... 90 inches.
Length of stroke, ... 12 feet.

Length of boilers,	28	"	6	"
Breadth "	13	"	14	"
Height " exclusive of steam chimney,	13	"	6	"
Number of furnaces,	8 in each boiler.			
Length of grate bars,	6	"	6	"
Internal diameter of tubes,			3	"
Diameter of smoke pipes,	.8	"	8	"
Height "	40	"		
Description of coal,	Bituminous.			
Combustion,	Natural draft.			

Diameter,	.	.	.	41 feet.
Length of blades,	.	.	.	10 "
Depth,	.	.	.	24 inches.
Number,	.	.	36.	

Remarks.—Floor timbers at throats, moulded 21 ins., sided 15 inches. Distance of frames apart at centres, 32 ins. Hull strapped with diagonal and double laid iron braces, 320 of them $5 \times \frac{7}{8}$. Floor filled in solid, and bolted fore and aft. C. H. H.

This is a modification of the beautiful instrument invented by Sir David Brewster. The improvement consists in employing, instead of the two small semi-lenses, one large one, which is rendered stereoscopic by cutting an ordinary plano-convex lens in half, removing more or less of the opposite outer diameter, and then transposing the pieces so that the original centre of the lens becomes the two sides, and the outer edges come together. The advantages obtained by this instrument is an increased facility for viewing as one the double pictures: only one adjustment is necessary for all sights, namely, increasing or diminishing the distance between the line and the double pictures. By using larger lenses of proper focal length, pictures of any dimensions may be viewed stereoscopically.

* From the Lond. Mech. Mag., Jan., 1856.

FRANKLIN INSTITUTE.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on J. D. Dale's Machine for Working Wood Mouldings.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, "Improvements in the Machine for working Wood Mouldings," invented by Mr. John D. Dale, of Philadelphia, Pennsylvania.—REPORT:

That, the invention and improvement consists in arranging a series of moulding cutters, or plane bits, side by side, along the length of, and around the axis of rotation, and securing them between adjustable cutter-heads, capable of being moved to conform with the size of the moulding designed to be worked. Combining therewith rotating saws, or their equivalents, for slitting or separating the several mouldings at the same operation.

The improved part of the machine may be described, as the rotating cutter-head, and the mouth pieces.

The cutter-head consists in a series of circular disks about 6 or 7 inches diameter, arranged upon a horizontal shaft, the two outer ones secured thereto near to the ends, and to four horizontal guide rods placed equidistant, and near to the peripheries; all the interior disks have horizontal motion upon the shaft and the guide rods.

These guide rods have cogs on their inner surfaces, and mesh in gear with the threads of screws formed on the periphery of hubs, surrounding the shaft, and capable of moving around and laterally over the same, being confined in concentric spaces formed in the disk, by means of plates on either side, in such manner as to enable the hubs to be turned, whereby the screws on the peripheries operate on the cogs of the guide bars, and move the disks towards each other, to gripe and hold the cutters inserted in grooves between them.

The stationary and movable disks have each one or more teeth, acting as saws, secured on their peripheries, of a sufficient projection beyond the moulding bits, for slitting the plank to the required widths of the mouldings.

The horizontal shaft with its rotating stock of plane irons, is mounted in boxes of a suitable form provided with the usual fixtures for feeding, guiding, and sustaining the plank. And upon each end of the shaft is hung an arm, having a bar with a slot in it, extending nearly its whole length; to the under surface of which bar, are secured a series of plates of hard wood, by means of screw bolts passing through the slots, so that the plates can be shifted at pleasure for adjustment. There is one of these plates for each set of moulding cutters, viz: for each division of the rotating stock, and the forward edge of each plate respectively fits close and accurately to the contoured edge of the cutters, being formed by shifting or pressing them forward upon the cutters sufficiently for the purpose, when the head is in operation.

This part of the improvement is called the mouth-piece, its advantages

being in all respects like to the same parts of the plane preventing the skelling or splintering of the plank by the cutters during the planing of the moulding.

It will thus be seen, that any number of moulding bits, may be arranged around, and secured side by side between the disks, on the same shaft, with slitting teeth or saws for dividing each set; or the slitting saws upon the inside disks may be removed, and the whole or any required width of moulding, number of members, &c., desired, may be worked out at one and the same passage of the plank through the machine. It appears to the Committee to work well, with or against the grain of the wood, and with speed; the time occupied in working the whole width of a board into a number of mouldings being about equal to that of a single moulding in machines heretofore in use.

The rotating head of the machine seen in operation by the Sub-Committee, had but a single cutter to each moulding, and the dividing saw tooth; yet the work produced was sufficiently smooth for a distance of 15 to 20 feet from the eye, and in the opinion of the Committee, if two or more bits were to be used on each surface to be planed, the work would be sufficiently smooth for the usual purposes near to the eye. But for such use Mr. Dale finds it more economical to finish the mouldings by planing off a few shavings by hand.

The improvement appears to be new, and of sufficiently useful importance to the arts to warrant the Committee in recommending it to the Board of Managers for the award of the Scott Legacy Premium.

These improvements of Mr. Dale, were patented on the fourth day of January, 1853; and on the tenth day of October, 1854.

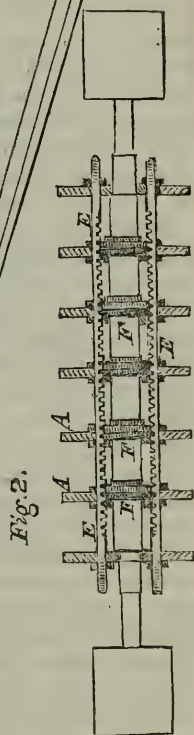
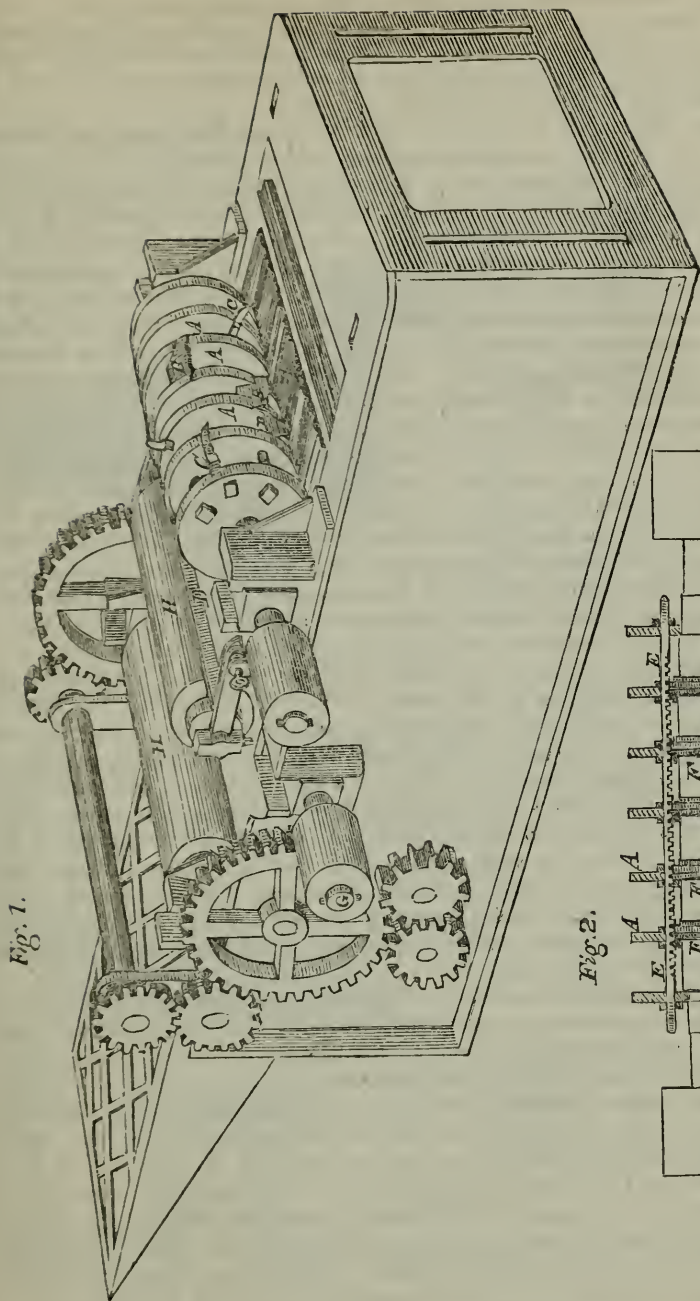
By order of the Committee,

WM. HAMILTON, *Actuary.*

Philadelphia, January 10th, 1856.

Description of Cuts by the Inventor.

Figure 1, represents a perspective view of the improved machine. Fig. 2, is a section of the rotating cutter-heads, and parts for moving and securing the same on their shaft. *A* are the cutter-head disks or circular plates, with grooves, in and between which the cutters *B*, are secured. *C*, are the teeth secured to the disks or circular plates, for slitting the board or plank to the required width of the mouldings, after the manner of a circular saw. *D*, is the mouth-piece frame, so suspended and secured in relation to the cutters, as to enable the contoured edges of the mouth-piece, corresponding in every respect with the form of the cutters to press upon, the edge of the plank being moulded immediately next where the cutting is being performed, so as to prevent skelling or splintering of the plank by the cutters during their cutting process. *E*, are the cogged bars for moving the disks and securing the cutters in the grooves between them. *F*, are the hubs having screw threads on their peripheries which mesh in gear, with the caps of the bars *E*, and being secured between plates secured to the disks or circular plates *A*, in such a manner as to enable the latter to be moved by the turning of the hubs. *G*, is the lower cutter head shaft for planing the lower surface of the plank. *H*, are the feed rollers. *I* are the ends of a series of mouldings in the act of being planed to the required form, by the cutters *B*, and separated by the teeth *C*.



Report on G. T. Parry's Anti-Friction Bearing.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, "Conical Anti-Friction Bearings," invented by Mr. G. T. Parry, of Philadelphia, Pennsylvania.—REPORT:

That, the object of the invention is to reduce the friction incident to revolving surfaces sustaining pressure, and it is intended to be applied principally to turn-tables, and to shafts transmitting end pressure, as propeller shafting, or vertical shafts whose weight is to be supported. It consists of a series of rollers shaped like double frustra of cones united at their bases, and therefore larger in diameter at some point between the extremes, to which the rollers taper uniformly. These rollers are interposed between two flat surfaces indented by grooves opposite each other; which grooves are shaped so that the extreme diameter of the rollers touches them at the deepest point only; and very nearly touches at the extremes, thus permitting a slight rocking motion.

It has been customary to support turn-tables on conical rollers, having the longest diameter furthest from the centre of revolution, and to restrain them in their tendency to separate by rods arranged as radial axes; but so far as the Committee is aware, Mr. Parry's idea of adding the outer cone for the same purpose is original with him. It has also been proposed to construct bearing collars for receiving the end thrust of propeller shafting, with one-ended cones as above described. This plan, however, is open to serious objection on account of the friction due to the tendency to separate coming on the collars of the radial axis.

Experiments made on two steamers, fitted with Mr. Parry's arrangement, one a propeller of 700 tons, the "*North Carolina*," the other a tow boat of small size, the "*Cushing*," showed the Committee that the gain by the use of Parry's arrangement over the plain collars, or in other words, the substitution of a rolling for a sliding surface, was from 6 to 8 per cent., when the sliding surfaces were kept constantly oiled. This result was naturally to be expected. As regards the durability of the apparatus, the reports from various boats having it in use are somewhat conflicting; but it appears generally established that the double cones when properly made and attended to are not liable to lose their shape, and that their operation is satisfactory. As regards turn-tables, the reports are of the same character.

The Committee are decidedly of opinion that the invention of Mr. Parry, forms an improvement to turn-tables, by diminishing the friction of revolution; and believe it to be one of the best known methods of supporting superincumbent weight revolving slowly.

In the case of propeller shafting where revolution is very rapid and continuous, they believe it to be a great improvement over the use of rubbing surfaces or plain collars; and although they are not prepared, from want of due experience in the durability of the apparatus, to say that it might supersede those well established methods of receiving thrust, they consider its advantages so marked as to warrant its use in conjunction with those methods, so that the gain resulting from diminished friction should be realized so long as the apparatus remains in working order.

It is proper to say that by the mode of construction adopted by Mr. Par-

ry, the replacing of rollers when worn is easy, and can be effected without loss of time; while their first cost is trifling, and hence the expense due to wear cannot be an item of much importance to sea-going steamers.

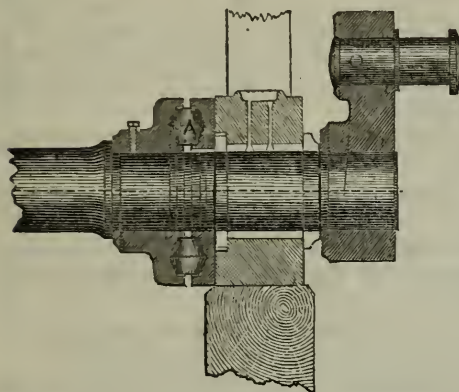
The Committee, therefore, hope that the invention may be generally introduced for the purposes designed, believing it to be an improvement over other methods in use.

By order of the Committee,

Philadelphia, January 10th, 1856.

WM. HAMILTON, *Actuary.*

Fig. 1.



Description of Cuts by the Inventor.

Fig. 1, represents the crank shaft of a propeller, with the box bearing against the pillar block; the rollers A, revolving with the shaft.

Fig 2. View as applied to the U. S. Steamers *Wabash* and *Minnesota*; the dotted lines represent the shaft; D D, rings on shaft for backing; the forward thrust on box, and rollers C.

Fig. 3. Railway turn-table; in this application, the under side of the box rests upon the upright A, supporting the table while it is revolving on rollers; E, wheel to hold up outer end of table.

Fig. 2.

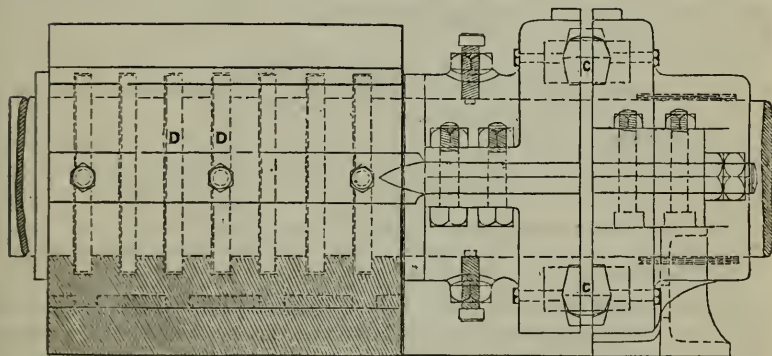
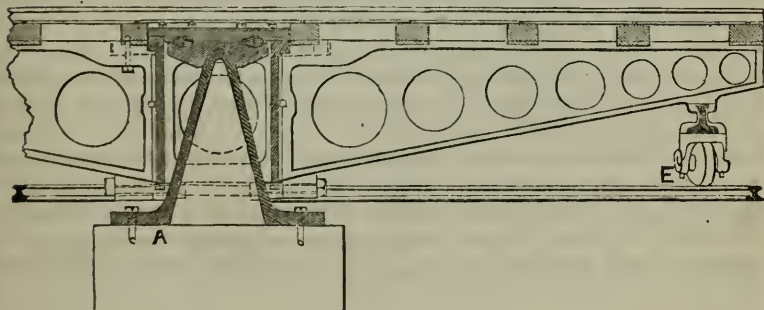


Fig. 3.



Proceedings of the Stated Monthly Meeting, March 20th, 1856.

Thomas S. Stewart, President, pro tem., in the chair.

John F. Frazer, Treasurer.

Dr. John L. Le Conte, Recording Secretary, pro tem.

The minutes of the last meeting were read and approved.

Letters were read from the Smithsonian Institute, and from Thomas U. Walter, Esq., Washington, D. C.

Donations to the Library were received from the Chemical Society, London; Thomas U. Walter, Washington, D. C.; The Massachusetts Charitable Mechanic's Association, and Daniel Treadwell, Boston, Massachusetts; The Board of Water Commissioners, Detroit, Michigan; The Sunbury and Erie Railroad Company; A. J. Brasier; A. B. Hutton and George M. Conarroe, Philadelphia.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer read his statement of the receipts and payments for the month of February.

The Board of Managers and Standing Committees reported their minutes.

Resignations of membership in the Institute by (9) gentlemen were read and accepted.

Candidates for membership in the Institute (5) were proposed, and the candidates proposed at the last meeting (8) were duly elected.

The Actuary reported the organization of the Board of Managers, and the following Standing Committees for the ensuing year, by the election of their chairman, and appointing the time for holding their stated meetings, as follows:

Board of Managers,	{ George W. Conarroc, Chairman, Isaac S. Williams, Owen Evans,	{ Curators.	} 2d Wednesday Evening.		
<i>Committees.</i>					
On the Library,	John Allen,	Chairman,		1st Tuesday	"
" Models,	William Smith,	"		1st Thursday	"
" Meteorology,	Alfred L. Kennedy,	"	2d Monday	"	
" Arts and Manufactures,	James C. Booth,	"	2d Tuesday	"	
" Meetings,	Washington Jones,	"	} Monday before 3d	"	
" Min's. & Geo. Specm's,	John L. Le Conte,	"			Thursd

Washington Jones, chairman of the Committee on Meetings, called the attention of the members to an improvement in speaking tubes, patented by Woolcock & Ostrander of New York, and sent for exhibition by Mr. Peter Rodgers. The improvement consists in the attachment of the signal whistle to the interior of the mouth piece by a hinge, which can be operated with a crank handle on the exterior of the tube. The whistle is made in a metal disk, which entirely closes the tube by resting upon a seat faced with leather, to prevent leakage of air when the tube is blown into to sound the whistle to attract attention, when a message is about to be sent. When two or more pipes terminate near the same point, the one being used, is indicated by a hinged piece of thin brass which covers the aperture of the whistle, until it is thrown over by the issuing air. The disk is opened by the crank when a message is being sent or received, and is closed by a spring, giving less trouble than in the

plan where the whistle is made in a plug, which, when not forgotten, is inserted in the mouth piece by hand.

Also, a new arrangement, by Mr. Kingston Goddard, of curb and snaffle bit, in which one pair of reins, formed of strong catgut, passes through the hollows formed in the middle of the other reins, when the edges are brought together and stitched, to give the leather the usual cylindrical shape. By it, fewer gears are visible, and the curb rein is always near the hand of the rider, ready for emergency. It is submitted by the inventor, to the Committee on Science and Arts for a report upon the new features.

Mr. T. S. Martin exhibited two American watch movements manufactured by Dennison, Howard & Davis, Waltham, Connecticut, one plain, the other full jeweled. They are remarkable as being the first watches ever made wholly by machinery. They combine the principle of the English patent lever, with that of the Swiss watch and detached lever. The power is direct from the main spring, no chain being employed. All the watches (of the same description) correspond, so that any part taken out of one will answer for another.

The manufacturers have expended \$100,000, for machinery and means for carrying on their operations. The machine is said to be remarkably ingenious, and finishes the work ready to be put together without extra hand labor.

Mr. Martin also exhibited a bar of the "new metal" Aluminum, together with a salt spoon, mustard spoon, and fork of the same material.

Dr. Rand laid before the meeting several specimens of improvement in Photographs, by Dr. G. Langdell.

Some four years since there were exhibited to the Institute, specimens of photography upon collodion. The pictures produced at that time, were very clearly defined, and effective, so far as accurate gradation of light and shade was desired, but the great contrast between full light and deep shadow gave to all of them a sombre cast, unpleasant in the general effect. In order to remove this defect, many attempts have been made to procure certain tones or tints of color common to the whole picture, so as to decrease the contrasts and give a neutral cast without affecting the gradations of light and shade.

How far these efforts have been successful can be judged from the specimens exhibited by Dr. Langdell. The colors he has selected are shades of orange and brown pink. These colors can be produced separately or any shade of their combination at the pleasure of the operator.

Mr. H. Howson exhibited an improved rattle for policemen, which was patented by James McCord, of this City, in November last. The improvement consists in securing the handle to the edge of the ratchet wheel, and at right angles to the axis of the latter, for the purpose of turning down the handle out of the way, thereby rendering the instrument more convenient to carry in the pocket, and for the further purpose of combining a mace and rattle in one instrument.

Mr. Howson also exhibited a model of an improved harvester rake, invented by Samuel Comfort, Jr., of Morrisville, Bucks County, Pennsylvania, for which he is about applying for a patent.

Mr. Howson also exhibited specimens of printing type of a peculiar form, for which a patent for a design was granted to Lawrence Johnson, Esq., of this City, in January last.

BIBLIOGRAPHICAL NOTICE.

A Treatise on Plane and Spherical Trigonometry. By WILLIAM CHAUVENET, A. M., Professor of Astronomy and Navigation, United States Naval Academy ; Third Edition. Philada.: Lippincott, Grambo & Co., 1854.
Great Circle Protractor. By Prof. W. CHAUVENET.

The subject of Spherical Trigonometry is by far the most difficult one which comes under the notice of a student of mathematics ; and the intrinsic difficulties of the subject have been increased heretofore by the fact that the treatises were either extended to unwieldy length, as well by including matters of detail which are seldom of practical use, as by tedious and intricate modes of demonstration ; or else in the effort to avoid this difficulty, fell into the opposite error of too great brevity by the omission of intermediate steps of the demonstrations, to an extent which renders it difficult for the student to follow them, and the neglect of matters which, though not formerly used, are now among the most important applications of the science. We have seen no text-book which has so well hit the happy mean between these opposite errors, as that of Professor Chauvenet. The work is comprehensive, and includes the case of the General Spherical Triangle, of whose properties, so much advantage has been taken in the labors of Professors Gauss and Bessel ; it is perspicuous, and as far as the nature of the subject allows of it, easy—so that we hope fewer candidates may be discouraged from their pursuits than formerly ; it is neat and simple in its language, leading the student into no digressions from the plain course of the reasoning. We have no doubt that it will form a very efficient text-book in the best class of our colleges and academies, and hope to see it largely adopted.

The Great Circle Protractor, of the same Professor, is a neat and ingenious practical solution of a problem of great importance to navigators : namely, to find without calculation or elaborate plotting, the shortest distance between two points on the surface of the earth ; that is, the arc of a great circle which passes through these two points. Now, this, upon an ordinary chart, is a matter of time and difficulty—and many able mathematicians and practical navigators have endeavored to attain a solution of sufficient accuracy to render it valuable in practice, while it was simple enough to be within reach of every commander of a vessel. But though this has been for years laboriously sought for, we believe Professor Chauvenet's plan is the first one which insures success, and a mere inspection of it will suffice to show, that while its accuracy is sufficiently correct for practical purposes, its simplicity leaves nothing to be hoped for or desired.

It consists simply of two superposed charts ; the upper one being of transparent material, so that the lines on the one below may be plainly seen through it ; on the lower chart are described the meridians and parallels in stereographic projection ; on the upper, or transparent sheet, a similar set of circles, of which, however, the meridians represent the system of great circles while the parallels serve as circles of distances. It is hardly necessary to follow out the description and show how the angle which the great circle at any point of its course makes with the meridian, and the distances run and to be run, may be at once read on the appropriate lines, as the chart is accompanied by a plain explanation, and directions, and sufficiently elucidated by examples to make it clear to any comprehension.

JOURNAL OF THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

MAY, 1856.

CIVIL ENGINEERING.

*Experiments to Ascertain the Effects of Grades and Curvature on
Railways.** By ALFRED SEARS, C. E., U. S.

So long as the clay in which we are moulded is of grosser fabric than the mind, so long as the hand is harder than the brain, just so long will machinery of all sorts fall in its practical application below the standard of duty marked out for it by the formulæ of the philosopher. When we have ceased our labors to elevate man, we may withhold our efforts to perfect his work.

Hence, then, till a result is accomplished, that shall render experience unnecessary, experience will be interesting and valuable. If the result obtained from data furnished by properly conducted experiments be found to modify accepted doctrines—they aid in bringing formulæ into practical shape, and thus, too, they produce a still nearer approach to *perfectness of adaptation* in the machine to which they apply.

Of especial importance are the recent experiments on the New York and Erie Railroad. In the subjects they reach, they are more extensive, in the influence they must exert more considerable, and in the effects, measured by a financial scale, as valuable as any other class of data that can be gathered from railroad practice. They yield truths to be regarded by the constructing engineer, and convey important suggestions to those having charge of the working of railroads—while they are also of interest to the locomotive machinist.

The object in view, at present, is to introduce the result obtained, more especially to the notice of the civil engineer and railroad superin-

*From the Lond. Civ. Eng. and Arch's. Jour., Feb., 1856.

tendent. They will give additional data for the calculation of the much vexed question "of the equation of distances," an important problem in engineering, and one that has been subject to much confusion. As to gradients, the cause of the difficulty is, that many eminent men, who should have known better, have confounded the *angle of repose* with the *angle of double resistance*.

The latter cannot be a constant quantity, but is governed by the circumstances of the load and its portage. The *angle of repose*, on the contrary, may for practical purposes be assumed as constant, $0^{\circ} 09'$ according with the latest experiments. This angle produces an inclination of which the rise is $\cdot 258$ of the length of the plane, equivalent to a grade of 13.7 feet in a mile—or referred to resistance to motion, is equal to a friction of 5.8 lbs. per ton.

This supposes the plainest case, being that of a car on a track without joints, and moving with a velocity indefinitely slow, a case in which atmospheric resistance amounts to practically nothing, the motion indicating only that friction is balanced. The amount of power used to produce this result is called the friction of the train. It expresses, however, but the friction of the cars of the train.

A comprehensive thought will at once convince the engineer of the fallacy in that equation by which this simple element is made the only resistance encountered or worth estimating.

The *angle of double resistance* varies with the load—the style of the engine—the velocity. Other causes affect it, but these are the principal, and are always present. Hence, in estimating the value of different lines, it is important to consider the kind of business to be accommodated; whether chiefly a passenger or freight traffic; light trains at high rates of speed, or heavy trains at less velocities.

This paper will present those results only that are founded on reliable data. It will, therefore, be necessary to avoid all consideration of works accomplished by extraordinary methods, and expedient to omit notice of those miles that are of such mixed construction in grade and alignment as to compel calculations on short sections with the use of *averages*—a dangerous element in such problems.

Those situations of the trains on descending grades, in which the breaks were locked, are of course incidental to all railway locomotion, but form no part of the phenomena to be now considered.

The organization of the trial train was completed on Monday, August 27. Operations began on Tuesday. The train left Dunkirk, the western terminus of the New York and Erie Railroad, at as early an hour as the state of the track would permit; a dry rail being necessary to a fair exhibit of the adhesive power of the engine.

The engine No. 210 was appointed to the performance of these duties.

Weight of engine, ...	66,000 lbs.
Weight of engine on drivers, ...	40,000 lbs.
Diameter of blast orifice, ...	2½ in.
Diameter of cylinder, ...	1417 ft.
Diameter of driving wheels (coupled), ...	5 ft.
Length of stroke of piston, ...	2 ft.

These figures are necessary elements in the calculations incidental to the experiment.

The formulæ made use of are those of De Pambour; and I have adopted the practical co-efficients determined by his experiments, when they have not been expressly ascertained for this purpose.

The experiments were made with heavy trains, the composition of which was regulated by the "ruling grade" of the various divisions of the road. These trains weighed, on different occasions of the trip, including engine, tender, and caboose, as follows, viz:—train designated for convenience

No. 1, composed of 25 cars.	982,140 lbs.
No. 2, " 30 "	1,145,790 "
No. 3, " 100 "	3,545,390 "
Weight of tender, roadworthy,	42,240 "

The width of the Erie railroad gauge is 6 feet.

To illustrate what has been said concerning "Equating for Grades," it will be interesting to estimate the amount of resistances to be overcome with some of these different loads before they can be moved on the track.

1. The atmospheric pressure of 14.7 lbs. an inch on each piston of which the area is 227 inches, may be reckoned as $2 \times 227 \times 14.7 = 6674$ lbs. But as the power of the engine is directed to the circumference of the drivers, it will be necessary to find the value of this element of resistance at the same point, to establish a relation between them as well as between this and the other resistances. The pistons travel two strokes measuring 4 feet, while the wheels make one revolution during which they have passed through 15.71 feet. Hence the proportion

$$15.71 : 4 = 6674 : x = 1699 \text{ lbs.}$$

2. The back pressure resulting from the construction of the blast orifice, and which depends on the velocity of the engine, may be represented when referred to the periphery of the driver by

$$\frac{4 \times 454p}{15.7} = 116p,$$

in which p = back pressure in pounds per square inch. Hence, then—

$$1699 + 116p =$$

the resistance in pounds arising from atmospheric pressure on the pistons and the action of the blast pipe.

3. Let T = number of tons (gross) composing the load, including tender, and f = friction of load, being the number of pounds required to move one ton upon the track; in this case 5.7 lbs. Then

$$fT =$$

resistance opposed by the friction of the load.

4. Let g = effect of gravity in pounds per ton, and W = weight of engine in tons gross, then

$$g(T + W) =$$

the effect in pounds produced by the gravity of the train; to be added to or deducted from the other resistances, as the grade is ascending or descending.

Then

$$f \cdot T \pm g (T + W), \text{ or } T (f \pm g) \pm g W =$$

the resistances opposed by the friction of the load and the gravity of the train.

5. We come now to estimate the resistance occasioned by the air through which the train is moving, and which must be considered as at rest, since no observations were taken to measure the amount of its effect. The amount of frontage may be called equal to the greatest cross section of the train increased by 10 square feet for each car, including engine and tender.

Let bv^2 = this resistance in pounds at the velocity v of the train; then

$$f \cdot T \pm g (T + W) + bv^2 =$$

resistance from friction of load, gravity of the train, and the air.

6. One other obstacle to the progress of the train remains to be considered—the friction of the engine.

Let F = the friction of unloaded engine, being in this case 348 lbs., or 12 lbs. per ton.

Let r = additional friction due the load, to be measured as a fraction of the resistances summed up in (5), being for coupled engines about 22. Then

$$F + r [f \cdot T \pm g (T + W) + bv^2]$$

will be the friction of the engine, when moving with the resistances here indicated. And we have for the *sum of resistances* encountered by this engine, when referred to the track,

$$S = 1699 + 116p + F + (1 + r) [f \cdot T \pm g (T + W) + bv^2]$$

Let us reduce this equation for a velocity of 23 miles per hour, being the average speed of train No. 1 during 2.26 miles, the most unexceptionable on a level tangent, as to attending circumstances; pressure in the boiler as indicated by the steam gauge being 124 lbs.

$$P = \text{atmospheric pressure on pistons, in lbs.} \quad . \quad 1699$$

$$p = 8; \text{ then } 116p = \quad . \quad 928$$

$$F = \quad . \quad 348$$

$$g = 0$$

$$f = 5.7 \text{ lbs. per ton gross.}$$

$$T = 438 - 29 = 409 \text{ tons gross.}$$

$$W = 29 \text{ tons gross.}$$

$$\text{Frontage of train} = 110 + 28 \times 10 = 390 \text{ square feet.}$$

$$bv^2 = 390 \times 1.6 \text{ lbs.} = 624 \text{ lbs.}$$

$$1 + r = 1.22.$$

Hence then

$$(1 + r) [f \cdot T \pm g (T + W) + bv^2] = \quad . \quad 3605$$

$$\text{and } S = \quad 6580$$

This amount of resistance is equivalent to the gravity on a grade of 35.3 feet per mile, which is the *grade of double resistance* for this train at a speed of 23 miles per hour, with a steam pressure of 124 lbs.

Train No. 2 with the same pressure in the boiler was removed 3.5 miles at the rate of about 20 miles per hour on a level tangent. In the same formula

$$p = 6; \text{ then } 116 p = 696 \text{ lbs.} \\ S = 512 - 29 = 483 \text{ tons gross.}$$

Frontage and effective surface of train is $110 + 33 \times 10 = 440$ square feet.

$$bv^2 = 440 \times 1.2 = 528 \text{ lbs.} \quad \text{Then } S = 6746 \text{ lbs.}$$

Gravity will equal this amount of resistance on a grade of 31 feet per mile.

Hence, then, other things being the same, we find that for train No. 1, moving with a velocity of 23 miles per hour, the grade demanding an outlay of power double the amount required on a level, is 35.3 feet per mile. In other words, for this train, one mile of 35.3 feet grade ascending, would equal two miles of level line. While for No. 2, moving at 20 miles an hour, the power must be doubled on a grade of 31 feet per mile.

Concerning the effect of velocity, we observe that with a load nearly one-fifth greater, the resistances are increased but 5 per cent. if the speed be reduced 43 per cent.

Thus, when a sufficient number of experiments have been made with care, it will be found valuable to prepare a table of results, and from this table the locating engineer may, with sufficient accuracy, determine the "equation of grades," for the class of road he is about estimating.

Though these reflections are independent of the experiments we are to consider, it is hoped they may not be thought useless. Nor will they, when it is remembered that important errors are frequently made by those who assume a constant quantity in "equating distances" on lines under investigation for estimates. So great is the error that not even an average can be made for trains presenting considerable differences in their composition.

In examining the data collected in a series of experiments on the effect of curvature, we shall notice greater departures from a formula based on any one, than in cases of grades on tangents. This will be the case in the present instance; for while on some parts of the road the track is properly prepared by bending to the curves, it is in other cases laid more carelessly, and is in some of the sharpest curves nearly straight. So that in passing from rail to rail the resistance from concussion is by no means inconsiderable.

In the following table will be found the results condensed, of all the reliable data gathered on 200 miles east from Dunkirk. The cases are gleaned from the mass and averaged; a practice, that, as before remarked, is dangerous, where entire accuracy is sought, yet one to which it is necessary to resort, unless the experiments are conducted with especial reference to this use. And even then, the results obtained on various roads, must be averaged for the construction of reliable tables for practical purposes.

The results are arranged to proceed from the simplest case to the most complicated, and are numbered as separate experiments. The first four

in the list are the average of many observations, and are used as corrections for the curves.

General Characteristic of Line.	Number of experiment.			Alignment.	Total Amount of Curvature in Degrees.	Boiler Pressure indicated by steam gauge in lbs. per sq. inch.	Effective Vaporization in cubic feet of water per hour.	Velocity actually accomplished, in miles per hour.	Velocity demanded by formula, on Tangent.	Difference for correction, in miles per hour.	Diff. due Curv. expressed as a fraction of the effect demanded
Level Tangent,	1	1	0	Tangent,	—	124	210	23.0	23.7	0.7	—
" "	2	2	0	"	—	124	190	19.9	20.9	1.0	—
" "	3	3	0	"	—	130	141	8.0	8.0	0.0	—
Ascend'g Tangent,	4	2	40	"	—	130	141	7.0	7.0	0.0	—
Level Curve,	5	1	0	1° Curvature,	53	125	210	22.5	23.7	0.8	-.01
" "	6	2	0	3° Curvature,	158	110	165	16.0	18.3	0.8	-.08
" "	7	1	0	Compound 1° 2° & 3°	85	120	165	18.3	20.0	0.8	-.045
" "	8	1	0	" 1¼° & 3°	82	120	165	17.9	20.0	0.8	-.065
Ascending Curve,	9	1	24	1° Curvature,	53	120	165	12.6	13.2	0.4	-.014
" "	10	1	40	4° "	211	130	136	5.4	7.4	0.0	-.27
" "	11	1	40	3° "	158	115	137	5.9	7.5	0.0	-.21

To ascertain the effect of curvature, we shall first examine the resistances opposed to each train as if on a tangent, then the total resistance actually overcome by the train on the various curves. The difference between those results will be the amount of resistance due curvature.

De Pambour's formula for the velocity at which a certain load may be drawn by a locomotive is used, with a change in the symbols for the convenience of those whose duties call them to know more of railroads than the dead languages.

The formulæ will then stand—

$$V = \frac{1}{5280} \cdot \frac{1}{q} \cdot \frac{1}{1+c} \times E$$

$$(1+r) [(f \pm g) T \pm g W + b v^2] + F + \frac{d \cdot l}{D} \left(\frac{n}{q} + a + 144 p \right)$$

velocity in miles per hour, when

E = Effective vaporization of the engine, in cubic feet of water per hour.

q = Factor expressing volume of steam proportioned to the pressure = .00000023 when the pressure is given in pounds per square foot.

n = Constant quantity relative to the volume of steam, its value being .0001421.

l = Length of stroke of piston.

c = Clearance of the cylinder, equal in this instance to $\frac{1}{32}$ of the use-

ful stroke of the piston, which gives $\frac{1}{1+c} = \frac{32}{33}$.

a = Atmospheric pressure, equal to 2117 lbs. per square foot.

d = Diameter of cylinder.

D = Diameter of driving wheel.

The total heating surface of the boiler = 1105 square feet. The diameter of blast orifice should have been stated at 3 inches. The equation when reduced by the substitution of these values will read—

$$V = \frac{798 E}{1.22 [(5.7 \pm g) T \pm g W + bv^2] + 348 + 0.8 (2736 + 144 p)}$$

To illustrate the use of this formula, let us apply it to the circumstances of train No. 1. We shall have by making proper substitutions, the equation

$$V = \frac{798 \times 210}{1.22 [5.7 \times 409 + 624] + 348 + 0.8 (2736 + 1152)} = \left\{ \begin{array}{l} 23.7 \text{ miles} \\ \text{per hour.} \end{array} \right.$$

It is thus we arrive at the amounts stated in the table under the head of "Velocity Demanded."

It is to be noticed that in the experiments on level tangents, the actual effect is somewhat below the estimated powers of the engine; also, that, as the velocity increases, the difference becomes greater.

This was perhaps to be expected. During a part of the time the adhesive power of the driver was affected by a leakage of the pumps, which wet the rail. The track is, moreover, exceedingly rough in places; though the quantity given above, as the friction of the cars, being 5 lbs. per net ton, is in accordance with information received from the general superintendent of the Erie road.

In addition to these causes of difference, it may be remarked that there was at times some wind; but as these are culled instances, it is believed they are free from any considerable influence beyond a quiet atmosphere. In No. 1, at a velocity of 22 miles per hour, there is a difference between the actual and possible effect, of 3 per cent. of the work done.

In No. 2, at a velocity of 20 miles per hour, this difference amounts to 5 per cent.

In No. 3, the velocity being 8 miles per hour, the difference was too slight to be noted.

In No. 4, at a velocity of 7 miles per hour, the difference was equally unnoticeable.

Suppose there be similar relations throughout, these amounts must for practical purposes, be applied as corrections to the experiments on curves.

If, therefore, the amounts in the column of differences be added to the velocity actually accomplished, and the sum be deducted from the velocity demanded, we shall have presented the effect of curvature, which in the table is noted as a fraction of the effect demanded, after correction.

It would be useless of course to found a law on these results. They are believed to be most carefully observed, and so far as they go are certainly correct. What are noted as single experiments, are really classes of observations. But we must have more considerable data from many roads before the results obtained can be made available for the purposes of the locating engineer—who, as before remarked, must be governed by the nature of the business to be done on the lines under consideration.

*On the Causes of Explosions of Steam Boilers.** By Mr. WILLIAM KEMBLE HALL, United States (America).

The different theories advanced to explain the action resulting in explosions, were examined and illustrated by the ordinary attendant facts. Inherent defects in design and material were sufficiently provided for, by the preliminary testing and the ordinary safety valve, and the deterioration by use could be guarded against by periodical examination. If the pressure of the steam was allowed gradually to increase, until it exceeded the strength of the boiler, the danger would be betrayed by some one of the numerous rivets and seams of its structure, as there was always some single point which would first give way. In the boiler which exploded on the 18th of August, at the Hartford Steel Works, Sheffield, the steam was at its usual working pressure of 40 lbs. per square inch, when a rupture took place in the side of the boiler, from which the steam issued with a furious hissing sound, warning the attendants of their danger and enabling them to escape. The side stays were defective and had failed. It was reasonable, then, to suppose, that the tearing of the boiler into several pieces, which generally accompanied explosions, was caused by a sudden exertion of power, and electricity had been suggested as an agent. But although electrical phenomena might be exhibited by the expansion of a jet of steam, it could not be supposed, that a boiler, with its many direct and metallic connexions with the earth, could be converted into a reservoir of electricity. If any were generated, it would be instantly conducted away. It had been supposed, that the plates exposed to the action of the fire by the falling of the water had become overheated and decomposed the steam, the oxygen of which had combined with the iron, and the hydrogen formed a gas, that had caused the explosion. But hydrogen would not explode, unless largely mixed with atmospheric air, which could not enter the boiler, except in minute quantities, forced through the feed-pump, in combination with water; and although there was evidence of the absorption of oxygen, in the rusting of the stays and of the interior surface of old boilers, it was too insufficient in extent, to warrant the deduction, that there had been an appreciable change in the chemical composition of the steam. It might be possible to produce an external explosion, but not an internal one.

In the explosion at the Consett Iron Works, Gateshead, early in November, it was in evidence, that the boiler had been blown out a short time previous, and the valve was not closed. The plates had been heated red hot, and it was supposed, that the attendant, who was killed, had discovered the deficiency of water, and had just opened the feed valve, at the instant when the explosion occurred. Now, heat did not lessen the strength of iron up to the temperature of 550° , and had it exceeded that point, in this case, and thus weakened the boiler, the result would merely have been a collapse of the flue. Water was not resolved quickly into steam by a red hot surface. The excessive heat repelled the particles, and they were slowly evaporated by the communication of heat through the intervening vapor. No great pressure, therefore, could have been

* Read before the Institution of Civil Engineers; London, March 4th, 1856.

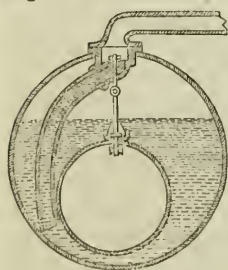
generated directly from this source. When heat was applied to steam, the increase of its pressure was governed by the same law that applied to air and all other elastic gases;—an addition of 480° only doubling its pressure. Experiments had conclusively proved the possibility of heating steam in contact with water, without also increasing the temperature of the bulk of the water, the upper stratum of which alone became heated by the contact. If, therefore, it was supposed, for example, that the steam had been heated to 435° Fahrenheit, and water suddenly injected into it, the pressure would have been instantly raised to that due to the presence of the water,—determined by the experiments of Arago and Dulong to be 360 lbs. per square inch at that temperature. Or, to use another illustration, while 1000° of heat applied to steam, would but increase its pressure, or volume, about three-fold, the same amount would multiply that of water 1700 times. This vast increase would certainly be modified, by the latent heat absorbed by the water in its conversion into steam, but served to indicate a sudden and local generation of excessive pressure, which might result in explosion.

The surcharged steam might be supplied with water, without the agency of the feed pump. At the explosion which occurred at Chiswick, July 16th, when the safety valve was in good order, and loaded to the average working pressure of 20 lbs. to the square inch, the boiler had been idle during the dinner hour, and the explosion occurred as the engine man was in the act of opening the stop valve, preparatory to starting the engine. The water had probably been low, and the sudden flow of steam into the pipes, partially relieved the water of pressure, and it was thrown by the agitation into intimate contact with the super-heated steam, and suddenly converted into vapor of too high a tension for the strength of the boiler. It was a well known fact, to those conversant with the practical management of steam boilers, that the water stood higher, when the engine was in operation, than when it was idle, and that it might be further raised by opening the safety valve. This effect was more apparent with a contracted water surface, and comparatively small steam room. An explosion which took place at the Tower Mills, Sheffield, August 11th, was an illustration. The surviving attendants positively affirmed, that observations of the water gauges, a few minutes previous to the accident, showed sufficient water; but an Engineer, deputed by the Coroner for the purpose, examined the boiler, and testified that it had been overheated, and that such indication was wrong, or had been misunderstood. The boiler exploded immediately after the attendant had made some preparation necessary for opening the safety valve, and probably at the instant he had opened it. The boilers that exploded at the Walker Iron Works, at Newcastle, October 8th, and at the Kebblesworth Colliery, September 19th, were each provided with a float and two safety valves. In both instances there was reason to believe that the water had been forced through the connecting feed pipe, from the boiler that exploded, into the adjoining one, and that in the latter instance, the attendant had observed the danger, and was engaged in opening the safety valve.

Experience had proved, that the fusible metal plug, enjoined by law in France, became encrusted by scale, and otherwise rendered inopera-

tive by use, and did not answer the purpose for which it was intended. The softer portions of a compound metal were forced out by the pressure to which it was subjected, and the remainder becoming oxidized, did not fuse at the temperature intended. It, moreover, acted merely as a warning, and did not serve to obviate the impending catastrophe.

All the contrivances hitherto adopted for the purpose of providing against explosions, were designed to supply water, when that in the boiler had fallen to too low a level, or to open the safety valve by the pressure of steam, independent of other circumstances. As had been illustrated by the examples alluded to, either of these plans would induce, in many instances, the very accident designed to be avoided. For there seemed every reason to believe, that the great majority of explosions were occasioned by the negligence of the attendant, in permitting the level of the water to fall below the flues, exposing the plates to a high temperature, and surcharging the steam with caloric, far exceeding that due to its pressure. In injecting an additional supply of water into the boiler, when in this dangerous condition, it was thrown over the heated plates and into the super-heated steam, and suddenly converted into steam of too high a tension for the boiler; and so instantaneously, moreover, that it operated with all the momentum of a blow. And as the water necessary to produce this disastrous result might be supplied to the surcharged steam, from that already in the boiler, by the agitation incident to the opening of the so-called safety valve, the alarming fact was presented, that the very instrument provided for insuring against explosions might become Fig.1. HALL'S APPARATUS. the cause of producing one.



These considerations naturally led to the conclusion, that safety was alone to be attained, by opening a water blow-off valve, when the surface of the water had fallen to a perilous extent, for the purpose of first discharging from the boiler the water, which was the more dangerous element, and then the steam; operating, in fact, as a safety valve, in a more useful but less objectionable position than the present steam-valve situated on the dome. The arrangement represented by the wood-cut illustrated the principle; it represented a valve communicating with the water, and kept in position by a rod which served for its stem, and terminated in a button cemented with tin, or other readily fusible metal, into a copper cup, riveted to the crown of the furnace. There were no working joints, or stuffing boxes, to become disordered, and the fusible metal was protected by the cup, composed of a material which was a rapid conductor of heat. If the furnace should be unduly heated, the button would be released, and the valve permitted to open and discharge the water and steam from the boiler. The boiler might be injured, and the flues destroyed by the fire, but no explosion could occur. This system had been subjected to trial under heavy pressure, and had been found very successful.

In the discussion, it was argued, that Mr. Hall's system, if properly carried out, would be extremely useful, and almost prevent the possi-

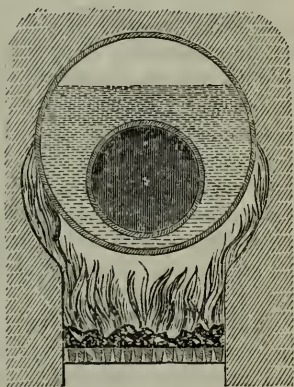
bility of danger from explosion ; but that it would be of use only when an explosion was almost inevitable, and that as prevention was better than cure, the utmost should first be done to prevent boilers reaching that state, still retaining Mr. Hall's valuable apparatus, in cases of all other means of prevention proving ineffectual. The

Fig. 2. INTERNAL FLUE FIRING.



majority of explosions were stated to arise from the practice of constructing the boilers with the fire-places in the flues (fig. 2), contrary to the system used in Cornwall, where they always arranged to have abundant boiler room and slow combustion ; but where flue firing was used, the boiler surface was too frequently deficient, and the firing rapid and generally forced. Plans were exhibited, showing this peculiar danger to be caused by the severest action of the fire being, of necessity, within the concavity of the fire flue, upon which there was but a few inches depth of water, and where the least neglect in its supply, would be fatal to the boiler plate, even if a repulsive action did not already cause a remittent rather than a constant action of contact of water with the plate ; besides which, the probability of the water, below the fire bars, not boiling at all, rendered the supply of steam weak, and easily exhausted, and led to undue firing and all its concomitant evils. The furnace constructed of masonry (fig. 3) was described as promoting the reverse of all these conditions. Many extracts, from known writers, bearing on the subject, were given, and it was attempted to be shown, that while there were fully as many under-firing as tube-firing boilers, at work, the majority of explosions took place in boilers of the latter class, and they almost invariably commenced with the collapse of the fire flue.

Fig. 3. UNDER-FIRING.



It was contended, that the only objection which could be raised against under-firing, was the danger of incrustation, or deposit upon the boiler bottom, of matter held in suspension by the water ; but that this rarely, if ever, caused explosions ; the utmost injury it occasioned, was causing the boiler plate to be burnt out, and that this effect could not take place, without gross neglect. The questions of the possibility of saturating surcharged steam, so as to dangerously increase its power ;—of hydrogen gas being formed in the boiler, and other theories of a similar nature, were avoided, as it was held, that each of these, supposing their possibility, must arise from the presence of unduly heated metal within the boiler, which it could not be doubted was the prime cause of nearly all explosions, and that a properly set under-firing boiler could never, except from the most culpable neglect, have any portion of its surface over-heated. It was also suggested, that, when it was necessary to stop the engines, instead of

closing the damper, it would be safer to leave it open, to close the ash-pit door, and to keep the fire door ajar.

The possibility of the water being repelled from the top of the flue, as shown in fig. 2, was contested, and it was argued, that the water would rather have a tendency to rise up the two sides of the tube, on account of the fire being in immediate contact with the side plates, and thus that the two currents would cause the water rather to heap up over the flue.

Many flue boilers were injured, by the flame being allowed to impinge too sharply upon certain parts, and in those spots the plates blistered, and were soon burned through; the best remedy for this was to give more flue space; and it would be found, that the quantity of steam generated would be increased, whilst the burning of the boiler would be prevented. In many cases of explosion, especially of locomotive boilers, it was evident, that the pressure had increased very gradually, and the steam had become surcharged with heat, so that when the explosion occurred, all the water was suddenly flashed into steam, as the rails and ground all around were quite dry.

It was doubted, whether the fusible metal might not, in practice, become partially fused, at a comparatively low temperature, and allow the valve to open prematurely; and it was urged, that it was safer to depend upon the care, skill, and intelligence of the engine-man, than upon any self-acting apparatus. Many serious accidents, particularly on railways, had arisen from the attendants being lulled into fancied security by having self-acting points, or other apparatus, which worked well for a time, until something went wrong, and then an accident ensued.

The flues frequently collapsed in consequence of their losing their circular shape by pressure, or from originally imperfect construction.

The spheroidal theory of M. Boutigny (D'Evreux) was discussed, and a doubt was expressed, whether any considerable quantity of water could be brought into the same state as the small quantities, upon which his experiments were tried. It was, however, contended, that if a boiler was heated to a very high temperature whilst empty, and the water was then suddenly injected and the aperture closed, an explosion would not occur instantly, because the water would have assumed the spheroidal state; but as soon as the temperature was reduced to the proper degree, the steam would be liberated in such a volume, and at such a density, as to burst the boiler.

In Cornwall, where it was acknowledged that the utmost economy of fuel was practised, the boilers were stated to be nearly all on the internal flue principle, and an accident was scarcely ever known to occur there. It was generally admitted, that the apparatus introduced by Mr. Hall, would be effective in preventing accidents, but that the main point was to have very ample boiler space, have no self-acting apparatus, and encourage great attention on the part of the engine attendant.

A new form of boiler was exhibited, and described as having been recently erected at the works of Messrs. Humphrys, Tennant & Dykes; the fire-box, of 3 feet diameter, was composed of a series of flanged rings of Low Moor iron, fastened together in such a manner, as that the rivets should be surrounded by water, and not be exposed to the action of the fire. The depth of water over the fire-box would be double that

over the small iron flues, or tubes, which were three inches diameter. No double thickness of plate was allowed anywhere. It was intended to supply steam of 70 lbs. per inch, and it had been loaded up to 120 lbs. per inch. The shell was much stronger than that of one of the Great Western locomotives, and it was anticipated that the steam might be permitted to accumulate without danger.

Several instances were given of explosions of locomotive boilers, presenting many apparent peculiarities, which were, however, all referable to natural causes; in some cases, a series of very peculiar circular holes, and in others grooves were found, extending all round the interior of the shell, near the rivets. The boilers had failed below the part where they were weakened by the bending over, probably a little too sharply, of the plates.

When it was remembered, that the explosion of a boiler, under a pressure of 140 lbs. per square inch, was nearly identical with that of a 10-inch gun, the effects of such an occurrence were not surprising.

In the cotton mills, the speeds of the machinery were increased, whilst the boilers became weaker from wear; under such circumstances, the occurrence of accidents was scarcely to be wondered at. When steam ceased to act merely by pressure and began to exercise momentum, peculiar effects must be anticipated; but they might all be traced to general, rather than to occult causes.

It was stated that nearly, if not quite, all the instances of explosions, recorded in the *Journal of the Franklin Institute*, were from boilers with under-firing, and they were generally considered in the United States, as less secure than those with internal fire-flues.

It was stated, relative to the explosion at Sheffield, that it was proved there had been a sufficiency of water over the tube, and yet that one portion of it must have been red-hot; at least, such was the appearance exhibited. It was contended that the effect of heaping up the water from the action of the side-plates, was not nearly so probable, as the repulsive action of the top of the flue, previously contended for; inasmuch as the latter action was more probable and natural. Also, that if, as had been stated, the water below the flue was unduly cooled at that part, the steam would be weak and deficient in quantity. It was reiterated, that if a boiler was of due strength, properly set, and carefully attended to, there was little danger of explosion, until the plates were too much weakened by wear and tear. With all boilers, Mr. Hall's apparatus would be a valuable adjunct, and in no case could be prejudicial.

The double-flue Cornish boiler was mentioned as being preferable to the single firing-flue; the surface exposed was more extensive, and the construction was stronger—the depth of water above the flues was greater—and firing could be alternate. All these were admitted advantages.

It was reiterated, that it was not necessary to have recourse to the spheroidal theory—to the decomposition of water—or to any highly scientific arguments, and much less to mysterious, or occult causes, for the reasons of explosions. Careful investigation would in general point sufficiently clearly to them, when the reasons were fairly sought for.

It was stated, that the observed cases of corrosion of the plates of boilers, might be referred to galvanic agency, and instances were given

of such effects being produced, when the bilge water was taken up by the feed-pumps and injected into the boilers. The sections of metal torn asunder, frequently presented proof of an instantaneous generation of explosive power, whether produced by over-heated plates, or any other cause ; and as the method of discharging the water and the steam from a boiler, would appear to be the most effectual mode of preventing danger, it would be only reasonable to employ so simple a precaution as that afforded by Mr. Hall's apparatus.

The opinion as to the little confidence to be placed in self-acting apparatus, in general, was agreed with ; but it was submitted that the self-acting looms, and other machines of that class, and the automatic action of the eccentric upon valve gear and other similar arrangements, would warrant deviation from the rule, under certain circumstances, among which it was claimed to place that of the spontaneous discharge of the water and steam from the boiler, in cases of a dangerous degree of pressure being attained.

The experiments of Watt and Southern were alluded to, as demonstrating that the latent heat of steam, at high temperatures, was progressively converted into thermometric heat, and the injection of water into surcharged steam would occasion a proportionate increase of pressure. A careful investigation of this subject, would probably confirm the alleged result of the experiments undertaken for Mr. E. K. Collins, of New York, which appeared to be that a saving of nearly 50 per cent. of fuel might be made by the use of surcharged steam.

The decomposition of water on heated plates, although admitted to be an interesting chemical study, was now generally rejected, as a practical solution of the question of explosion ; and as to the spheroidal theory, any such pressure of steam as must exist within a boiler, would practically force the water into absolute contact with the heated surface, and would not permit the globules to be suspended amidst the film of steam, at atmospheric pressure, as in an open crucible, or on a plain heated plate. Therefore that theory must almost be abandoned in practice.

The causes of explosions might, at first sight, appear to be difficult of discovery, but careful investigation generally brought to light evidence of some condition of the boiler, under which an accident would be inevitable. The difficulty of arriving at the facts was great, after the occurrence of explosions, but there were few cases which did not exhibit undue weakness in some parts of the boiler, or undue steam pressure, without adequate means of affording relief.

In the case of the explosion of the locomotive boiler which had been mentioned, it was well ascertained, that the cross stays upon the fire-box top were rather too short, and thus had their bearing inside, instead of upon the exterior periphery. Explosions might be generally attributed to equally simple causes, and it was impressed on the meeting to seek for them, rather than to raise theories upon some occult causes, the existence of which was very problematical.

Mr. Hall's apparatus might, with advantage, be applied to all boilers, but it would be more useful if, as an invariable adjunct, it could take with it a careful, intelligent fire-man, without which no boiler could be considered safe.

AMERICAN PATENTS.

List of American Patents which issued from March 18th, to March 25th, 1856, (inclusive,) with Exemphifications.

MARCH 18.

95. For an *Improvement in Welding Steel*; Homer Anderson, Garrattsville, N. Y.

Claim.—"The compound of sulphate of soda and carbonate of soda, made up and used for welding metal surfaces."

96. For an *Improved Bench Plane*; Lewis C. Ashley, Troy, New York.

Claim.—"Combining a metallic throat piece with a plane stock, in a manner independent of the plane iron, to keep the mouth of the throat of the plane perfect, as the plane stock shall wear away."

97. For an *Improved Apparatus for Roasting and Broiling by Gas*; James B. Blake, Worcester, Massachusetts.

Claim.—"The roaster and boiler."

98. For an *Improved "Dumb-jockey," the "Cross" and Saddle-tree being made of Gutta Percha*; Samuel Blackwell, Middlesex County, England; patented in England, March 9, 1853.

Claim.—"Making the cross and the saddle-tree of gutta percha, and thus a new article of manufacture."

99. For an *Improvement in Hermetically Sealing Preserver Cans*; Charles Branwhite, City of New York.

Claim.—"Confining the top of the can between bearing surfaces, by means of the collar and screw, thereby dispensing with solder or cements, in forming a joint. Also, the peculiar form given to the internal and external bearing surfaces of this attachment for closing a can when formed."

100. For an *Improvement in Hernial Trusses*; John Broiles, Madison County, Ala.

Claim.—"The peculiar adaptation of the steel ribbon to the body of the patient, by making its lower edge flared out, the block or circle end flared out on its upper edge, for about two inches—the strap end slightly curved upwards, and the block end curved downwards and outwards on its upper edge, in combination with a pear-shaped pad, having a slice taken off, commencing at the outer edge of the base, and continued to about two-thirds its length towards the seam, thus forming a broad plane surface, to be applied to the body of the patient."

101. For an *Improvement in Grain and Grass Harvesters*; Thomas D. Burrall, Geneva, New York.

Claim.—"1st, The shoe piece and rack, to adjust the height of the outer end of the finger board. 2d, The arrangement of the shaft in the journal, with its pinion taking the wheel when combined with the bent arm."

102. For an *Improvement in Making Chilled Castings*; William Butler, Little Falls, New York.

Claim.—"The combination of the hollow chilled cones with the sand core, for the purposes of obviating the difficulty of warping and springing, attending the casting of cast iron boxes on chills, and thereby forming a chamber in the box."

103. For an *Improved Carriage Coupling*; Thomas Chope, Detroit, Mich.

Claim.—"Attaching the perch of a vehicle to the front axle, in a manner which will enable it to turn or rock, by means of a slotted T shaped bar, which is attached to the front axle, by means of clips—and the slides—both working in the slots, at right angles."

104. For an *Improvement in Threshing Machines*; Hiram Clark, Princeton, Mass.

Claim.—"The use of the pieces for separating the grain, by an action similar to that of a flail, in connexion with the rollers and aprons, or other similar device."

105. For an *Improvement in Mowing Machines*; Samuel Comfort, Morrisville, Penn.

Claim.—"The employment in mowing machines, of an endless chain of cutters, which shall traverse along the cutter bar, and a sufficient distance above the same, to allow the mown grass to drop between the said chain."

106. For *Improvements in Machines for Corking Bottles*; Henry N. De Graw, Piermont, New York.

Claim.—"Securing corks in bottles and other vessels containing liquids charged or impregnated mechanically with carbonic acid gas, by having proper cork holders attached to the bottles or vessels, and closing the jaws of the same by the levers and jaws, or other analogous device, immediately after the corks are forced into the bottles by the piston, so that the holders will secure the corks in the bottles as soon as the piston is withdrawn from them, whereby the corks are secured in the bottles without removing the bottles from the bed or platform of the apparatus, and consequently, the operation of charging the bottles with gas, placing the corks therein and securing them in bottles, performed at one operation."

107. For an *Improvement in Fire Places*; Calvin Dodge, Pittsburgh, Penna.

Claim.—"The use of a deep recess or chamber, placed back of the fire basket of the grate, and out of the reach of the draft, in combination with the horizontal covering over the recess and fire basket, extending down below the mouth of the chimney, for the purpose of consuming the smoke and causing the ignition of the gas, which would otherwise be lost, and thus increasing the amount of heat thrown into the room, and by the slow combustion of the fire, effecting a great saving of fuel."

108. For an *Improvement in Grain and Grass Harvesters*; Eliakim B. Forbush, Buffalo, New York.

Claim.—"1st, The adjustable shoe, for the purpose of leveling the platform. 2d, Suspending the pole to which the team is attached, from a hinged journal upon the axle of the driving wheel, in order that the draft of the team, when moving forward, may be directly from the axle of the driving wheel, (leaving the frame, finger bar, and cutters, free to oscillate, and independent of the pole and the draft of the team,) and also, when backing, the power of the team may be exerted upon the frame, in rear of, and below the axle of the driving wheel."

109. For an *Improvement in Feed and Blow-off Apparatus for Steam Boilers*; Jacob Frick, Philadelphia, Pennsylvania.

Claim.—"Arranging a check valve and stop and blow-off valve in one instrument for steam boilers, for the purpose of avoiding the attachment of the separate and distinct connexion hitherto employed for the same purpose. 2d, The pressure valve with its weighted lever, as connected with the alarm valve, and as arranged with the check and stop valve."

110. For an *Improvement in Seeding Machines*; John German and C. B. Haigh, Oriskany Falls, New York.

Claim.—"Having the elbow lever upon a screw rod, so that said lever may be moved in and out of line with a portion or all the pins on the wheel, for the purpose of causing the slide to be operated faster or slower, or to remain stationary."

111. For an *Improved Inkstand*; R. Gleason, Jr., Dorchester, Mass.

Claim.—"The use of the hollow elastic body, in combination with the peculiar valve employed, for the purpose of retaining the ink within the cup."

112. For an *Improved Nut Machine*; Robert Griffiths, Alleghany City, Penna.

Claim.—"The use of the compressions, punchers, saws, levers, crank, and traveling head, for the purpose of making nuts from heated bars."

113. For an *Improvement in Harvester Cutters*; Horace L. Hervey, Quiney, Illinois.

Claim.—"Furnishing the cutter bar with a series of inclined blades or knives, in combination with a series of inclined blocks, or their equivalents, for giving to said cutters, or cutter bar, an oblique cut."

114. For an *Improved Mortising Tool*; A. C. Hitchcock and C. H. Amidon, Greenfield, Massachusetts.

Claim.—"The combination of the bit with the hollow slotted chisel."

115. For an *Improved Arrangement of Rotary Planing Knives*; Daniel N. Hurlbut, Utica, New York.

Claim.—"The arrangement of the cutters, and manner of securing them to the cutter rim of the wheel."

116. For an *Improved Illuminating Grating*; Joshua K. Ingalls, Brooklyn, N. York.

Claim.—"1st, The spheroidal lens, or pane with rounded edges, set in gearing or perforated plates of wood or metal. 2d, The grating of wood or metal, with tapering apertures, and glazed with lens or panes, of the form and in the method set forth."

117. For an *Improvement in Processes for Making Transparent Window Shades*; Edward R. Kernan, Pittsburgh, Pennsylvania.

Claim.—"The making of flexible or pliable and semi-transparent oil cloth for window shades and other similar purposes, by a series of processes."

118. For an *Improvement in Churns*; Lucius Leavenworth, Freemansburgh, N. Y.

Claim.—"The arrangement of the cords or bands attached to the pulley, and also to the staff, being wound on the staff to give a required rotary motion."

119. For an *Improved Self-Regulating Wind-wheel*; A. Lempche, Pleasant Mount, Pennsylvania.

Claim.—"The spiral spring, or its equivalent, in combination with the weighted levers."

120. For an *Improvement in Percussion Projectiles*; John Lippincott, Philadelphia, Pennsylvania.

Claim.—"The combination of the cylindrical chamber, piston, spiral spring, cap and nose piece, forming an improved percussion apparatus, to be inserted into the powder chamber of bomb shells, either in combination with or without a shallow sabot of lead, of the shape described."

121. For an *Improvement in Stoves*; James B. Maybury, Jeffersonville, Indiana.

Claim.—"The surrounding the fire place of a stove of any size or form, with at least two or more air jackets, standing in no communication with each other, admitting no currents of heated air, to circulate through them, and each of them provided with only one valve, for the purpose of controlling the radiation of heat from the outermost shell of the stove without interfering with the fire in the interior thereof."

122. For an *Improved Machine for Felling Trees*; Ebenezer Mathers, Morgantown, Virginia.

Claim.—"The method of straining the saw, by means of the curved elastic arms, and the adjustable bar."

123. For an *Improvement in Cone Tubes for Winding Frames*; John M'Crone, Thompsonville, Connecticut.

Claim.—"The use of the crystal as a material, for the cones or trumpets, used for shaping and consolidating yarn of woolen, cotton, or other materials, on bobbins."

124. For an *Improvement in Processes for Making Elastic Rubber Cloth*; Richard M'Mullin, New Brunswick, New Jersey.

Claim.—"Rendering vulcanized india rubber for the manufacture of shirred goods adhesive, by boiling it in a solution of potash, to remove the sulphur from its surface—thus fitting the sheet of rubber to receive a coat of cement, whereby it is caused to adhere firmly to the cloth, or other fabric, between which it is placed."

125. For an *Improvement in Seed Planters*; Elijah Morgan, Morgantown, Virginia.

Claim.—"In combination with the dead hoppers, the chamfering or beveling of the ends of the seeding bar, and the scolloping of the shield, so that any grain that may be carried to the ends of the seeding bar, may be forced by it into said dead hopper."

126. For an *Improved Machine for Making Clothes Pins*; George W. Parker, Fitz-William, New Hampshire.

Claim.—"The use of holes in a wheel, or of tubes secured to a wheel, and into which the pieces of wood are fed, and are thus retained in, and carried forward to the proper position to be acted upon by the lathe, saw, or bit. 2d, A sliding or vibrating lathe and

tail block, whereby the pieces of wood to be turned, are carried forward to the action of the cutters, or chisels. 3d, The cutters or chisels, in combination with the lathe and poles. 4th, In combination with the holes, a saw, or bit, and a sliding or vibrating carriage or holder, or its equivalent, to convey the pieces from the holes to the saw or bit."

127. For an *Improvement in Sectional Fire Pots for Stoves and Furnaces*; Merritt Peckham, Utica, New York.

Claim.—"Forming the fire pot of stoves, furnaces, &c., of sections, when said sections are constructed and secured together."

128. For an *Improvement in Boxes of Railroad Car Axles*; David R. Perkinpine, Philadelphia, Pennsylvania.

Claim.—"The movable piece, the vertical portion of which forms the front, and the horizontal portion of the bottom of the box, in combination with the preparations, and groove on the latter, for the purpose of quickly exposing the whole interior of the box, for examination or cleaning, and as quickly covering the same."

129. For an *Improvement in Harness Buckles*; Nathan Post, East Cleveland, Ohio.

Claim.—"1st, Attaching to a three barred buckle, the flanches, which keep the trace or straps in the centre of the buckle. 2d, The tube on the centre bar made loose, so as to revolve thereon. 3d, The block or foundation, with its stationary tongue."

130. For an *Improvement in Omnibus Registers*; James Rodgers, City of New York.

Claim.—"The mode of locking the ratchet wheel, by making the operating pawl pass at the end of its motion, beneath or against the ratchet teeth, so as to lock the wheel in place."

131. For an *Improvement in Machines for Sawing Marble in Taper Form*; Charles A. Shultz, Chicago, Illinois.

Claim.—"Adjusting the saw, by means of the swinging pulleys, acting laterally upon it, with the pulley regulating the tension."

132. For an *Improved Mode of Producing Designs on Wood*; Philipp Schwickardt, Brooklyn, New York.

Claim.—"The production of veins, streaks, drawings, pictures, and designs, on the plane surface of the woods, by means of pressure; the forms or dies, and the application of the same, for the production of views, streaks, drawings, pictures, and designs; the exclusive use of the design produced through the body of woods, when compressed between proper forms, and the combination of two or more kinds of woods, to produce the mosaic or inlaid work, by compressing, joining, and separating them."

133. For an *Improvement in Adjusting the Brasses of Connecting Rods*; John R. Sees, City of New York.

Claim.—"The combination of the bridge piece and the wedges."

134. For an *Improvement in Nail Plate Feeding Machines*; John P. Sherwood, Fort Edward, New York.

Claim.—"The use of the grooved eccentric cam, with its friction roller and bar, in combination with the slotted cylindrical cam, nipper handle, and female screw, operating to produce the peculiar movements necessary for feeding the nail plate in nail machines."

135. For an *Improvement in Sewing Machines*; Isaac M. Singer, City of N. York.

Claim.—"The method of distending or gathering up the cloth or other substance, where the needle operates upon it to form the seam, by combining in a sewing machine, two distinct feeding wheels, or their equivalents, moving with a differential motion."

136. For an *Improvement in Machinery for Making Hat Bodies*; A. B. Taylor, Newark, New Jersey.

Claim.—"The arrangement for hardening the hat body in a dry state, by machinery. Also, the method of facilitating the removal of the bat from the perforated cone, by means of a blast of air forced through the cone."

137. For an *Improvement in Harness for Shoeing Horses*; William P. Thomas, Hillsboro', Indiana.

Claim.—"1st, The combination of the windlass with the traces, the tugs, tail lever,

or single-tree—these or their equivalents, by means of which the horse is brought to his place, and secured from lateral motion. 2d, The combination of the windlass with the ropes and the hames—these, or their equivalents, by means of which, the horse is prevented from rearing or moving backward. 3d, The combination of the cords with the pulleys, the breeching and the traces, such an arrangement of the parts, that the breeching is firmly held in its place, by the weight of the horse. 4th, The combination of the back band with the pawl, the pulley, the rope, and the breeching—these, or their equivalents, by means of which, the horse is prevented from raising his hinder parts, and the breeching is prevented from rising up. 5th, The sliding bar, by which the horse is prevented from pulling his foot away, while the front shoes are being driven on."

138. For an *Improvement in Argand Lamps for Burning Resin Oil*; Isaac Van Bunschoten, City of New York.

Claim.—"Deflecting a portion of any passing draft or current of air, up the exterior air tube, by means of the wings, or their equivalents, to counteract the suction, or partial vacuum, produced at the other portion of the lamp, by said passing draft or current of air. 2d, The wings, or their equivalents, applied around the wick tube, to cause any sudden draft or current of air, to be deflected with equal force up into the cone and external draft, and down into the drip cup and internal draft. 3d, The separate transparent cone, within the chimney, rising only to about the height of the button. 4th, The sleeve or cup, combined with the perforated wick tube, and inclosing said perforations."

139. For an *Improved Adjustment in Boring Machines*; Israel W. Ward, Birmingham, Pennsylvania.

Claim.—"Having the cylinder in the curved axis and the shaft in the straight slots cut in the pillar blocks, and uniting the journals by the braces, so that they may be adjustable, but always be held in gear with each other. Also, the hollow auger shanks, so arranged as to slide over the stationary shafts, as they are forced out or drawn back."

140. For an *Improved Method of Suspending Circular Saw Spindles*; Hiram Wells, Florence, Massachusetts.

Claim.—"The arrangement and application of the eccentrics, with respect to the shaft boxes, and their stationary and adjusting screw pieces."

141. For an *Improvement in Stripping Top Flats of Carding Machines*; George Wellman, Lowell, Massachusetts; patented in England, Nov. 25, 1853.

Claim.—"1st, The combination of the segmental gear, with its projecting rim, and the pinions with their attached notched plate wheels, all as applied to the shafts, for the purpose of giving the alternate intermittent movements to the shafts. 2d, The arrangement of the mangle pins, &c., in the arc of a circle, upon the centre of which, the frame carrying the stripping apparatus vibrates, for the purpose of avoiding intermediate gearing, and consequent back lash. 3d, The combination of the cams with the chain belt, the chain pulleys, and shaft. 4th, The combination of the cams with the levers, carrying and operating the stripper card. 5th, The combination of the cams with the lifting rod and the levers. 6th, The combination of the springs and the pins, and their application to the frame. 7th, A mechanism for cleaning the stripper card. 8th, The segmental gear and its rim, as applied and operated, for the purpose of giving motion both to the mechanism, for raising, stripping, and depressing the top card, and to the mechanism; the moving and stopping mechanism from one top card to another—not moving both at the same time, but alternately first one and then the other."

142. For an *Improvement in Spinning Wheels*; Lyman Wight, Benton, Penna.

Claim.—"Attaching the spindle of a band spinning wheel, to a vibrating pendulum, and operating the same."

143. For an *Improved Machine for Tunneling Rocks*; Charles Wilson, Springfield, Massachusetts.

Claim.—"1st, The circular formed as a short hollow truncated cone, for acting on stone or other material. 2d, A continuously revolving wheel, provided with circular rolling disks or cutters, the axis of which cutters stand alternately in opposite directions, or nearly at an angle of 45° with the shaft of said cutter wheel—thereby acting to excavate the rock or other material. 3d, The arrangement of the alternating inclined tapering planes and stocks, for the purpose of sustaining and adjusting the alternate rolling cutters. 4th, The construction of the shaft, cylinder, and parts attached, when

used in connexion with the socket, set screw, and binding strap. 5th, The general arrangement of the cylinder and shafts and gearing attached, for rotating the drum and pressing the same forward."

144. For a *Safety Apparatus to be Applied to Harnesses and Thills of Vehicles*; Jas. H. Wilson, Jr., Nashville, Tennessee.

Claim.—"Attaching the horse directly to the shafts of one horse vehicles, by means of the boxes, which are secured to the harness, a box at each side of the box—the boxes being constructed of two hinged or jointed sides, so that they may be opened when necessary by the driver."

145. For an *Improved Method of Adjusting Reciprocating Saws*; J. Z. A. Wagner, Philadelphia, Pennsylvania.

Claim.—"1st, Having the saws within the saw sash or gate, on or to nuts, which work or are fitted on right and left screw rods. 2d, Operating or adjusting the saws laterally in the saw sash or gate, by means of the pinion placed loosely on the shaft, so that said shaft may work freely through it, the shaft having bevel pinions at its ends, which pinions gear into corresponding pinions at the outer ends of two of the screw rods. 3d, Connecting and disconnecting the screw rods, by means of the levers and arm."

146. For an *Improvement in Cut-off Gear for Steam Engines*; Orville Leonard, Somerville, Mass., Assignor to self and George H. Reynolds, Medford County, Mass.

Claim.—"The rocker, the toe, and the bar."

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147. For an *Improvement in Propelling Vessels*; Lambert Alexander, City of N. Y.

Claim.—"Regulating the motion of the propelling buckles, by the combined action of the spring blocks, inclines, rollers, and inclines."

148. For an *Improvement in Needle Guns*; Gustav A. Blittkowski and Frederick W. Hoffman, City of New York.

Claim.—"1st, The method of withdrawing the needle, by a positive force applied thereto, by means of the knob upon the needle stock, in combination with the claw upon the end of the hammer, so arranged, that becoming disengaged at the moment of giving the blow, it shall cause the withdrawal of the needle in the operation of cocking. 2d, The guide tube, for the double purpose of guiding the needle, and acting as a stop around the touch hole."

149. For an *Improvement in Detaching Boats from their Tackle*; Charles H. Key, Baltimore, Maryland, Administrator of S. F. Blunt, deceased.

Claim.—"The use of the weight of the boat when out of the water, to keep in place the contrivance for sustaining it, so that it shall no longer be sustained when the boat takes the water, and the weight is transferred to the latter."

150. For a *Machine for Cutting Loaf Sugar*; Adolph and Felix Brown, City of New York.

Claim.—"1st, The application and use of two or more rollers having brushes around their circumferences, and acting upon both sides of slabs of sugar, for the purpose of cleaning off the dust adhering to the same, by the process of sawing, thereby reproducing the appearance of the crystals. 2d, The application of drums or rollers connected together by gearing, having steel knives inserted and attached around their circumferences, forming squares and corresponding to each other, and acting on both sides of sugar slabs simultaneously like pincers, for the purpose of cutting up said slabs into regular morsels."

151. For an *Improvement in Breech Loading Fire Arms*; Ambrose E. Burnside, Bristol, Rhode Island.

Claim.—"1st, The use of a cartridge case made partially or wholly of soft metal, in combination with the beveled mouth in rear of the barrel, and the movable chamber of a breech loading fire arm, for the purpose of packing the joints thereof. 2d, The movable cartridge case, operating to eject the empty cartridge case."

152. For an *Improvement in Regulating the Flow of Oil to the Wick in Carcel Lamps*; Abraham Coates, City of New York.

Claim.—"Regulating the supply of oil to the burner, by means of the self-emptying drip cup, operating upon the supply valve."

153. For an *Improvement in Presses for Pinching*; George H. Corliss and Elisha Harris, Providence, Rhode Island.

Claim.—"The oscillating box, applied and operating within a yoke."

154. For an *Improvement in Fruit or Grain Dryers*; Charles W. Davis, Newark, New Jersey.

Claim.—"The inverted earthen cone, having an adjustable parabolic rim, with or without the hoop."

155. For an *Improvement in Stone Drilling Machines*; Josephus Echols, Columbus, Georgia.

Claim.—"1st, The cylinder with the apertures in its heads; the double valve with its hollow stem, and the tube with its cups. 2d, The gripper, operating in combination with a ring to grip and let go the drill bar. 3d, Furnishing the interior of one of the metal cups with spiral vanes, to be acted upon by the water, for the purpose of turning the bar at every stroke."

156. For an *Improvement in Paddle Wheels*; Calvin Fletcher, Cincinnati, Ohio.

Claim.—"The construction of propellers with a series of narrow buckets, of curvilinear or parabolic shape, for the purpose of combining the greatest propelling force with the least possible resistance to the ingress or egress of the buckets, in their passage through the water."

157. For an *Improvement in Water Coolers and Filterers*; John S. Gallaher, Jr., Washington, D. C.

Claim.—"1st, The application of combined chemical refrigerative agents, salt, charcoal, and gypsum, and a mechanical evaporating or air chamber, formed with a convex, inverted conical sloping or tapering cover or top, and a corresponding bottom part combined in use with a saturated cloth, and through all of which means, the ascending diffuse vapor is condensed, accumulated, and returned into its original volume, purified and cooled at the same time simultaneously. 2d, In combination with the condensing medium, and chemical refrigerative agents, the purifying or filtering devices, with the capillary agents and porous disks, through all of which chemical action and mechanical devices, is produced a compact individual, or unity cooling filtering apparatus."

158. For an *Improved Lath Machine*; Jesse Gilman, Nashua, N. H.

Claim.—"The clutch, operated by or through the medium of the lever and cams, in combination with the rods, carriage, and pulleys, the pulleys being connected respectively with the carriage and rod by the cords."

159. For an *Improvement in Steam Radiator Cocks*; Stephen J. Gold, New Haven, Connecticut.

Claim.—"The automatic closing of the cock on the filling of the radiator with steam, by means of a loose disk in the head of the cock."

160. For an *Improved Miniature Case*; Halvor Halvorson, Boston, Mass., Assignor to Slocum and Watkinson, Hartford, Connecticut.

Claim.—"The combination of the metallic dished bearing plate, the leather or embossed covering, and the two frames, the whole constituting one portion, or half of the case. Also, in combination with the metallic confining frame, and the velvet covered glass holder and frame—the frame made of pasteboard or other equivalent."

161. For an *Improved Pile Driver*; J. W. Hoard, Providence, Rhode Island.

Claim.—"The sectional 'ram' of the driver."

162. For an *Improvement in Explosive Shells*; William W. Hubbell, Philadelphia, Pennsylvania.

Claim.—"Combining or forming a series of oblique or propellor surfaces uniformly around the fuzee hole, on the extreme front face of the metal of an enlarged or thickened head of an elongated shell, with cylindrical body, and smooth semi-spherical hinder part."

163. For an *Improvement in Fan Rocking Chairs*; Konrad Kiefer, City of N. York.

Claim.—"1st, The fans when adjustable. 2d, The employment of a fan beneath the seat."

164. For an *Improvement in Fan Rocking Chairs*; Benjamin M. Lewy, Montgomery, Alabama.

Claim.—"A pendulum or self-acting driver, so applied to any rocking chair or cradle, or other rocking article of furniture, so that it will act by its inertia, to direct the fans."

165. For an *Improvement in Spring Platform for Railroad Cars*; Charles H. Lewis, Malden, Mass.

Claim.—"Connecting the guard to the box platform, by elastic band springs and a check chain, or its flexible equivalent, so as to enable the guard to adapt itself to the movement of the platform."

166. For an *Improved Piano-Forte Action*; N. Murphy Lowe, Boston, Mass.

Claim.—"The peculiar manner in which I have arranged the spiral springs upon the rod as applied between the hammer and the key."

167. For an *Improved Method of Cooling and Ventilating Rooms, &c.*; A. S. Lyman, City of New York.

Claim.—"The combination of a descending conduit or cold air flue, with a reservoir for containing cooling materials."

168. For an *Improved Carpenters' Bench*; J. W. Mahan, Lexington, Illinois.

Claim.—"The construction of a work-bench, together with the peculiar construction of the planes for jointing and facing."

169. For *Improved Machine for Sweeping Streets*; Joseph Miller, Boston, Mass.

Claim.—"Arranging the main driving shaft, its clutch lever and clutch in the upper and front part of the cart body, in order that the shaft may not only be unobstructed by the earth piled in the body, but have its clutch lever disposed within easy reach of the driver."

170. For an *Improvement in Gun Locks*; Edwin P. Monroe, Charlestown, Mass.

Claim.—"The pins, in combination with the coiled spring."

171. For an *Improvement in Wardrobe Bedsteads, combined with other Furniture*; Henry R. and James L. Plimpton, Westfield, Mass.

Claim.—"Constructing a bedstead with suitable parts attached thereto, in such a manner, that when not in use as a bedstead, it may be folded up and turned upright, and when in that position, by placing therewith a toilet table or wash-stand, or any other article of similar appearance, the whole apparently will form a secretary, book-case, wardrobe, cupboard, or any other similar piece of furniture."

172. For an *Improvement in Levers of Railroad Car Brakes*; Lucius Paige, Caven-
dish, Vermont.

Claim.—"The improved arrangement of levers and springs, and their application to the brakes of a railway carriage having swiveling truck frames—the same consisting in arranging two levers, so that they shall cross one another, and work on one common fulcrum, applying springs between said levers, and on opposite sides of the fulcrum, respectively, connecting both arms of the one, or the longer of the said levers, with the draft chain or rods of two windlasses, situated at opposite ends of the carriage body or platform, and respectively connecting the two arms of the other lever to the draft rod or chains of the brake levers."

173. For an *Improved Valve-motion for Oscillating Engines*; Horatio O. Perry, Buffalo, New York.

Claim.—"The valve motion as arranged in relation to, and in connexion with the loosely attached hollow throated and partially rotating valve."

174. For an *Improvement in Grain Separators*; Cyrus Roberts and John Cox, New Hope, Pennsylvania.

Claim.—"1st, The method of facilitating the separation of the grain from the straw, by means of diverging bars. 2d, Constructing the rear portion of the conveyor with a

solid rigid bottom, in such manner as to form a series of diverging channels, to spread the grain preparatory to delivering it to the winnower. 3d, The employment of shaking fingers, arranged and operated in such manner, that they will rise on the forward movement of the conveyor, and thus lift and shake the straw as it is thrown forward, in combination with the carrying bars, whereby certain advantages are obtained. 4th, The arrangement of shaking fingers, in a recess in the bottom of the conveyor, in such manner, that they can be alternately protruded above, and re-braced below the carriage bars, to shake the straw thoroughly, and at the same time not to interfere with its conveyance. 5th, The adjustable turning tail spout."

175. For an *Improved Field Fence*; J. B. Reyman, Salem, Indiana.

Claim.—"Forming a support for fences by means of angularly placed stakes, in combination with the mode of connecting them together and to the fence, by means of the wire, or its equivalent—the stakes and wire being so proportioned and arranged, that the act of driving the stakes into the ground shall tighten the wires and bind the whole together."

176. For *Improved Portable Field Fences*; James Rowe, Tampa Bay, Florida.

Claim.—"The construction of field fences, with shouldered laps perforated, and with upright battens on opposite sides of the string pieces."

177. For an *Improved Post Driver*; James M. Sampson, Waynesville, Illinois.

Claim.—"The segmental wheel, in combination with pinion and wheel, operating the drum upon the shaft."

178. For an *Improvement in Machines for Sizing Hat Bodies*; Albert Spencer, City of New York.

Claim.—"The application and use of the combination of the disk wheel and the rubber bed, when the bed receives a vibratory motion."

179. For an *Improved Clamp for Planking Ships*; Solon Staples, Bath, Maine.

Claim.—"The combination of the shank, arm, screw, and brace, with the rigid sliding tie."

180. For an *Improvement in Steam Boilers*; O. M. Stillman and Stephen Wilcox, Jr., Westerly, Rhode Island.

Claim.—"1st, Such arrangement of a series of vertical coils of different diameters, that when placed one within the other, spaces shall be left between—thereby forming flues, which allow the fire to act upon each of the said coils. 2d, The arrangement, in combination with the coils of a reservoir or boiler, placed within the inner coil, in such manner, that the greatest effect of the heat upon both will be obtained."

181. For an *Improvement in Syringe Bottles for Medicinal Agents*; John Stull, Philadelphia, Pennsylvania.

Claim.—"The combination and arrangement of a syringe and bottle, so that the latter shall serve as a protective case for the former, as well as a receptacle for the medicament to be used thereby."

182. For an *Improved Water Metre*; Andrew J. Sweney, Wheeling, Virginia.

Claim.—"The combination of two cylinders and two pistons with one head, common to both, having the parts thereto attached, forming a cheap and effective metre, but with little liability to get out of order."

183. For an *Improved Cock for Steam, Water, &c.*; William Thomas, City of N. Y.

Claim.—"The position in which the method is employed or used to raise and lower the valve, viz : in having the screw thread cut upon the opposite end from the band wheel, and inner end of the valve stem, and a corresponding screw thread cut within the fixed screw nut, which is of sufficient depth as to allow the screw upon the stem, to work sufficiently far as to raise and lower the valve without disconnecting itself—whereby the whole arrangement can be better and more easily and substantially constructed, kept in order, and operated."

184. For an *Improvement in "Creepers" to Prevent Slipping on Ice, &c.*; William H. Towers, Philadelphia, Pennsylvania.

Claim.—"Forming the 'crawler' of three plates, having calkins or pins on their

lower surfaces, and bent at their outer ends, and jointed together at their inner ends, and in such relative position to the sides and back portion of the heel of the boot or shoe, for which they are designed, as will enable their outer ends to move eccentric with the curves of the said side and back portion, to secure the 'creeper' to the heel, and their security of attachment to be increased by the act of planting the foot of the wearer in walking."

185. For an *Improvement in Wrenches*; William Warwick, Pittsburgh, Penna.

Claim.—"Providing a shank with a recess, whose one side is toothed, and the other is smooth, in combination with a pawl placed into said recess, on the inside of the sliding jaw."

186. For an *Improvement in Cotton Seed Planters*; A. W. Washburn, Yazoo City, Mississippi.

Claim.—"1st, The peculiar shape and arrangement of the ridge former, and the adjustable channel former, by which their forward movement enables them, when suitably loaded, to unerringly form a perfectly smooth channeled ridge. Also, the combination of the inclined flanches with the inner periphery of the rotating seed dropper, when they are placed in such positions with relation to the discharging apertures, and have such a degree of inclination, that the said flanches prevent the seeds from being discharged out of the front (or descending) side of the said seed dropper, and cause the seeds to be freely discharged through the apertures in the rear (or ascending) side of said seed dropper, in view of the operator."

187. For an *Improved Butter Worker*; James H. Bennett, Bennington, Vermont.

Claim.—"The rotating bowl, in combination with the horizontal bar and spatula."

188. For a *Self-setting Rat-trap*; Samuel Beaumont, City of New York.

Claim.—"Attaching the door to the platform, and supporting said platform when elevated or inclined, by means of the swinging rods or arms, which are connected to the bait hook by the levers—and having springs attached, so that the platform, when the animal nibbles the bait, will have its supports drawn from underneath it, and be allowed to descend and close the door—the door and platform rising to their original position, when the animal passes off the platform into the compartment of the box."

189. For an *Improvement in Machines for Sawing Marble in Obelisk Form*; John A. Bailey, Detroit, Michigan.

Claim.—"The peculiar means employed for gradually moving the saws laterally or apart in the saw frame as said saw frame descends, viz: having the pulley attached to the centre of the right and left screw rod, and a chain passing around said pulley, and also around pulleys at the outer end of the pitman—the ends of the chain being attached to the upper and lower ends of the rod, to which the outer end of the pitman is attached, and on which it slides—motion being communicated from one screw rod to the other, by any known means."

190. For an *Improved Cultivating Plough*; Micajah Crenshaw, Springfield, Texas.

Claim.—"In combination with the series of cutting plates or disks, the series of reciprocating hoes, when the hoes are so arranged as to work in lines parallel with the cutters or disks, and so inclined downward and rearward, as to readily rise up over any obstructions without danger of clogging or choking."

191. For an *Improvement in Tools for Figuring Morocco*; Samuel Green, Lynn, Massachusetts.

Claim.—"Making figuring tools for leather of agate, glass, flint, or other similar silicious materials."

192. For a *Water Wheel*; John Haseltine, Goffstown, New Hampshire.

Claim.—"Making the water partitions of the floats radial—the second portion tangential, and the third and last portion to incline downwards from the shaft, and from the tangential portion, when the same or the several parts are constructed so that the water will act against the two first by propulsion, and upon the latter by its weight."

193. For an *Improvement in Machines for Sawing Marble in Obelisk Form*; Issachar A. Heald, Springfield, Mass.

Claim.—"The rock shafts, provided with arms having friction rollers at their ends,

the rock shafts being operated by the bar, having pins upon it, between which the roller on the pin works, said pins being attached to the reciprocating frame, for the purpose of raising and lowering the saws at each end of their stroke, so that sand may be admitted into the saw kerfs."

194. For an *Improved Mould for Earthen Vessels, Pots, &c.*; Philip Schrag, Washington, District of Columbia.

Claim.—"The combination of the mould, made in two separate parts; one for the sides, the other for the bottom of the vessels, with the lining of the same with india rubber, or any other suitable material, which is fastened on both parts of said mould."

195. For an *Improvement in Machines for Raking and Loading Hay*; D. H. Thompson, Fitchburgh, Mass.

Claim.—"The combination of levers with rakes."

196. For an *Improvement in Cotton Hillers*; A. W. Washburn, Yazoo City, Miss.

Claim.—"The lifting-up plates of my improved cotton hiller, when arranged and operating in conjunction with the governing plate and the hilling ploughs."

197. For an *Improvement in Cotton Scrapers*; A. W. Washburn, Yazoo City, Miss.

Claim.—"The bevel wheels, for supporting and guiding the machine, when they are arranged in conjunction with the side scrapers and the thinning-out cutter, or either of them."

198. For an *Improvement in Grain and Grass Harvesters*; Abner Whitely, Springfield, Ohio.

Claim.—"1st, Forming a joint by means of the plates and the lugs, of sufficient strength to support the ground wheel, and retain the driving cog wheel in gear, while running, without any other connexion with the main frame. 2d, Placing the driver's seat on the opposite end of the frame from the joint, in such a manner, that the driver's weight when seated on it, shall balance some portion of the frame work, &c., of the machine, and throw the weight thus made to balance each other on to the wheel, while the angle of the cutters and fingers is preserved. 3d, Bracing the finger piece, so as to make it self-supporting."

199. For an *Improved Printing Cylinder*; Justus Webster, Boston, and Samuel H. Folsom, Lowell, Mass.

Claim.—"The construction of the printing cylinder, consisting of metallic rings or disks, placed upon a shaft side by side; the longitudinal marks upon the paper that is printed by it, being produced by those disks having an unbroken perimeter, while the intermediate disks which produce the cross lines, have a broken or toothed surface; the combined disks being secured to the shaft, by a spline, with suitable collars and nuts at the ends."

200. For an *Improvement in Hand Corn Planters*; William Jenks, Alexandria, Va.

Claim.—"The 'bolsters' and distributor, in combination with the point."

201. For an *Improvement in Ash Sifters*; Charles Jones, Brooklyn, New York.

Claim.—"The use of the sieve, in combination with the double acting cranks and rods, for suspending the sieve, for the purpose and in the manner of arrangement of parts in any suitable ash box."

202. For an *Improvement in Scythe Fastenings*; Thomas C. Ball, Walpole, N. H., Assignor to Nathaniel Lamson, Shelborne, Mass.

Claim.—"The cylinder."

203. For an *Improvement in Harvester Cutters*; John H. Manny, Rockford, Illinois, Assignor to Peter H. Watson, Washington, D. C.

Claim.—"The reversible duplex sickle."

204. For an *Improvement in means for Regulating Variable Cut-offs for Steam Engines*; Henry S. Hopkins, Assignor to Hopkins, Hendrick & Peckham, Providence, Rhode Island.

Claim.—"Combining the reversed inclined plane with the main inclined plane of the regulator and valve mechanism. Also, combining the movable stop-block, with the two inclined planes."

295. For an *Improvement in Wrenches*; Halsey D. Walcott, Assignor to H. D. and M. E. Walcott, Pawtucket, Mass.

Claim.—"The core, pin, spring, and inclined bearing."

206. For an *Improvement in Horse Power*; Richard Hunt, Freeport, Illinois.

Claim.—"The combination of the central pivot and annular track, secured to the ground, with a master wheel fitted with a central eye, and an annular series of conical supporting wheels, whereby the usual supporting frame, to combine these several parts, is dispersed with, while the requisite steadiness of the master wheel is maintained."

207. For an *Improvement in Construction of Cisterns*; William D. Bartlett, Amesbury, Mass.; dated February 19, 1856.

Claim.—"A cistern."

ADDITIONAL IMPROVEMENTS.

1. For an *Improvement in Excavating Machines*; J. J. Savage, City of New York; patent dated January 8, 1856, additional, March 11.

Claim.—"The adjustable brace, or its mechanical equivalent, in combination with the oscillating connecting arms, the combination being substantially as set forth. Also, the adjusting guide, or its mechanical equivalent, operated as described. Also, the tripping scoop, having a stationary back firmly bolted and braced to the scoop staff, which back forms a rest or shoulder for giving firm support to the scoop in its excavating operation, the scoop being affixed to the staff and operating as specified."

2. For an *Improvement in Mash Machines*; Adolph Hammer, Philadelphia, Penna.; patent dated January 9, 1855; additional, March 18.

Claim.—"The construction, application, and use of the inclined curved teeth."

3. For an *Improvement in Gas Burners*; Charles H. Johnson, Boston, Mass.; patent dated June 26, 1855; additional, March 18.

Claim.—"Extending up into the gas distributor and purifier, and among the wires of the latter, a cone having at its apex the inlet opening for the passage of gas into the purifier, the same serving to attain advantages as explained."

RE-ISSUES FOR MARCH.

1. For an *Improvement in Spark Arresters*; David Matthew, Philadelphia, Penna.; patent dated Dec. 31, 1840; extended, Dec. 27, 1854; re-issue, March 4.

Claim.—"The combination of the cone and deflecting head with the wire gauze inside of the outer case, to deflect the steam, gases, and sparks downwards, retain the sparks, and allow the expanded steam and gases gently to escape through the gauze. Also, forming the chimney of sections with the base of the upper section enlarged beyond the diameter of the top of the section below it."

2. For an *Improvement in Grain and Grass Harvesters*; Abner Whitely, Springfield, Ohio; patent dated Feb. 5; re-issue, March 11.

Claim.—"1st, Changing the angle of the fingers and cutters of reaping and mowing machines, while the machine is in motion, and the finger piece resting on the ground as described. 2d, So constructing the machine, that the driver is enabled while the team is in motion, and the boxes of the master wheel shaft being rigidly connected with the main frame, to change the angle of the fingers and cutters without moving the finger piece from the ground."

3. For an *Improvement in Machinery for Splitting Match Splints*; Benona Howard, Assignee of Lewis Smith, City of New York; patent dated May 28, 1848; re-issue, March 11.

Claim.—"1st, The use of the arrangement of the four cutters, arranged and operating as set forth, in combination with the cutter frame or box, and also, the use of the cutters and cutter frame, arranged and operating as hereinbefore described, in combination with an adjustable cap or clearer plate, for the purpose of holding the blocks of wood while

under the action of the cutters as described. 2d, The jointed levers, or their equivalents, with or without springs at their back, for the purposes set forth, and their combination with the cutters and crank motion or other equivalent device for working or operating a crimper for crimping or matting the surface of the blocks of wood. 3d, The use of the crimping or compressing levers, in combination with the bed board, for crimping or matting the lower surface of the blocks as described. 4th, The use of the shafts and ratchet feed wheels, for the purpose of feeding the blocks through the machine, in combination with the adjustable cap or clearer plate and bed board, when used for the purpose of splitting blocks of wood."

4. For an *Improvement in Railroad Cars*; Bernard J. La Mothe, City of New York; patent dated April 4, 1854; re-issue, March 18.

Claim.—"The construction of the frames of railroad cars in the manner specified."

5. For an *Improvement in Machines for Making Nuts, Washers, &c.*; William Kenyon, Assignor to Haigh, Hartuppee & Morrow, Steubenville, Ohio.

Claim.—"1st, The use of the die and die box, for severing the blank; the close die box, in combination with the dies and bracket, for pressing, and the punch for perforating the same during the pressure, the whole operating as herein described, for making nuts and washers at one operation. 2d, The manner herein described of so arranging the dies in relation to the punch that any excess of iron in the blank shall be forced into the path of the punch, thus securing the compression of the nut without risking the breaking of the machine."

6. For an *Improvement in the Machine for Forming the Web for Cloth of Wool, Hair, or other suitable substance*; Union Manufacturing Company, Assignees of The Legal Representatives of John Arnold, deceased, Norwalk, Conn.; patent dated July 15, 1849; extended from March 28, 1854; re-issue, March 18.

Claim.—"I do not claim as my invention the carding machines or any parts thereof, in common use; but I do claim the combined use of them, as herein described, for the purpose of crossing the fibres of the material of which cloth may be made, and the new machinery necessary to effect that object, particularly the comb carrier, the means described for severing the weft or web, and the fallers for placing the weft upon the warp, as described. Also, the depositing of the weft in separate sheets, edge to edge, upon the continuous sheet of warp."

7. For an *Improvement in Sewing Machines*; Sidney S. Turner, Westboro', Mass., Assignor to Elmer Townsend, Boston, Mass.; patent dated August 22, 1854; re-issue, March 25.

Claim.—"The arrangement of a hook or hook needle underneath, and so as to work up through the feeding bar, in combination with the arrangement of the presser above the feeding bar, and so as to press downwards towards it, such enabling me to obtain an important advantage in operating by the single chain stitch sewing machine. Also, arranging and operating the awl and the hook needle as described, that is, so that they may not only pierce in opposite directions the material to be sewed, but be withdrawn in opposite directions therefrom. Also, in combination with the mechanism for giving the vertical movements to the needle the slots—and the screw or pin—(or mechanical equivalents therefor,) for producing reciprocating semi-rotative movements of the needle, during the vertical movement of it."

8. For an *Improved Arrangement of means for working and stopping Chain Cables*; Thomas Brown, London, England; patent dated July 25, 1854; patented in England, April 20, 1847; re-issue, March 25.

Claim.—"The arrangement of the capstan, the removable rollers, and the sockets for said rollers, in such a manner, and having such relations to the hause holes, chain locker, deck pipes, and under lifting stoppers, that a chain cable can be continuously hove in by means of said capstan and rollers, or be directly run out of the lockers without any previous overhauling. Also, the flaring out and radially flanged annular recess in the capstan, when it is given such a shape that in handling a chain cable, the series of cavities in the faces of said recess will so perfectly adapt themselves to the varying lengths and widths of the links of the cable that it can be safely and securely handled when the cable has only a partial turn around the capstan. Also, the arrangement of the within described, under lifting bow stoppers and after stoppers, by which more cable can gradually and controllably be given to a vessel while riding heavily at anchor."

9. For an *Improved Sawing Machine*; William P. Wood, Assignor to self and John S. Gallaher, Jr., and John S. Gallaher, Jr., Assignor to William P. Wood, Washington, D. C.; patent dated Feb. 26, 1856; re-issue, March 25.

Claim.—"Attaching saws to parallel rocking beams, by means of swivel bearings. Also, the reversible graduating scale gauge, in combination with the saw teeth."

DESIGNS FOR MARCH.

1. For a *Design for Parlor Stoves*; Samuel D. Vose, Albany, New York; patent dated March 4.

Claim.—"The combination of the various ornaments and mouldings on the several plates, the whole forming an ornamental design."

2. For a *Design for the Handles of Forks and Spoons*; Theodore Evans, City of New York; patent dated March 4.

Claim.—"The peculiar form and figure, as the design for either side of fork, spoon, ladle, and knife handles, the said articles being manufactured of metal of any known kind."

3. For a *Design for Elevated Oven Stoves*; Samuel W. Gibbs, Assignor to W. and J. Treadwell, Perry, and Norton, Albany, New York; patent dated March 18.

Claim.—"The combination and arrangement of ornamental figures and forms, represented in the accompanying drawings, forming together the ornamental design for the plates of a cooking stove."

LAW REPORTS OF PATENT CASES.

For the Journal of the Franklin Institute.

Winans vs. New York and Harlem Railroad Company.

An action at law was brought by Ross Winans against the New York and Harlem Railroad Company, for the infringement of Letters Patent, granted to Ross Winans, October 1, 1834, and extended for seven years by the Commissioner of Patents. The nature of the invention, claimed by Winans, will appear from the Letters Patent, to be not merely the running of cars upon eight wheels, but it is the manner of arranging and connecting the eight wheels which constitute the two bearing carriages with a railroad car, so as to cause the body of the car or carriage to pursue a more smooth, even, direct, and safe course, than it does as cars are ordinarily constructed, both over the curved and straight parts of the road. For this purpose he constructs two bearing carriages, each with four wheels, which are to sustain the body of the passenger or other car, by placing one of them at or near each end of it. The two wheels on either side of these carriages are placed very near to each other; the space between their flanges being no greater than is necessary to prevent their contact with each other.

Having thus connected two pairs of wheels together, he united them into a four-wheel bearing carriage, by means of their axles and a bolster of the proper length, extending across between the two pairs of wheels, from the centre of one spring to that of the other, and securely fastened to the tops of them. This bolster must be of sufficient strength to bear upon its centre a load of four or five tons. Upon this first bolster he

placed another of equal strength, and connected the two together by a centre-pin or bolt, passing down through them, and thus allowing them to swivel or turn upon each other in the manner of the front bolster of a common road wagon. He prefers making these bolsters of wrought or cast iron; wood, however, may be used. He prepares each of the bearing carriages in precisely the same way.

The body of the passenger or other car, he made of double the ordinary length of those which run on four wheels, and capable of carrying double their load.

The most important feature of his invention he considers to be the closeness of the fore and hind wheels of each bearing carriage, taken in connexion with the use of two bearing carriages, coupled as remotely from each other as can conveniently be done for the support of one body, for by the contiguity of the fore and hind wheels of each bearing carriage, while the two bearing carriages may be at any desired distance apart, the lateral friction from the rubbing of the flanches against the rails is most effectually avoided, whilst, at the same time, all the advantages attendant upon placing the axles of a four-wheeled car far apart, are thus obtained.

This case was tried before Judge Nelson and a Jury at New York, in November, 1855.

Judge Nelson's charge to the jury, contained a full examination of the law of facts of this important case; it is therefore given at length.

GENTLEMEN OF THE JURY : The first question in this case is—what is the thing, the machine, or instrument which the plaintiff claims to have invented? It is essential to comprehend this, in order to ascertain whether it is new—never before known, or in public use; and is also essential to enable you to determine whether the cars used by the defendants are a violation of the patent. It will be necessary, therefore, in the first instance, to turn your minds to the patent and the description of the improvement claimed, and which is there to be found. The description, I think I may say, is one of unusual clearness and precision for instruments of this character. We have had no difficulty ourselves in ascertaining from it the improvement as claimed by the patentee, as it defines not only the arrangement and construction of the car—the running gear and the body—but also the principles governing the same, and upon which the improvement is founded. The patentee refers in the beginning to the numerous curvatures in the railroads of this country, the radius of which, in many instances, is but a few hundred feet, and to the friction arising between the flanches of the wheels and the rails, causing a loss of power, and destruction of both wheels and rails. He then refers to the high velocities on railroads by the modern improvements in locomotive engines, and the demand of public opinion—of the business interests of the country—for this description of speed, and also to the consideration, that certain things in the construction of both roads and cars become important which were not, and would not have been, at the old rates of speed. He observes that the great momentum of the load and intensity of the shocks and concussions are among the things to be noted and

provided for. The patentee then refers to the fact, that passenger and other cars, in general use upon railroads, have but four wheels, the axles of which are placed from $3\frac{1}{2}$ to 5 feet apart, the distance being governed by the nature of the road upon which they are run, and other considerations. He then observes that, when the cars (meaning the four-wheeled cars) are constructed so that the axles retain their parallelism, and are at a considerable distance apart, there is, of necessity, a tendency in the flanges of the wheels to come in contact with the rails, especially on a curvature of a short radius, as the axles then vary more from the direction of the radii; and that, from this consideration, when taken alone, it would appear to be best to place the axles as near each other as possible, thus causing them to approach more nearly to the direction of the radii of the curves, and the planes of the wheels to be more in the line of the rails. But there are other considerations, he says, that must not be overlooked in the construction of the car, namely, the increased force of the shocks from obstructions at high velocities; and he observes that the greater the distance between the axles, while the length of the body remains the same, the less is the influence of these shocks and concussions. In consequence of this, he says, a compromise is most commonly made between the evils resulting from a considerable separation and a near approach, as, by the modes of construction now (meaning then) in use in respect to the four-wheeled cars, one of the advantages which he has referred to must be sacrificed to the other. The patentee then refers to the fact that the lateral curvatures of the roads, together with their irregularities, create these difficulties—are at the foundation of these difficulties. It becomes very important, therefore, he observes, both as regards comfort, safety, and economy, to devise a mode of combining the advantages derived from placing the axles a considerable distance apart, with those of allowing them to be situated near to each other.

Now, gentlemen, this is a result to which the patentee arrives, after his discussion of the various difficulties to be encountered in the construction of the car, and it may be said to be the leading idea—the general principle—the fundamental principle, if you please—embodied in the eight-wheel car, and which he has subsequently described. I will call your attention to it again, because it brings out the principle upon which the eight-wheel car has been constructed by the patentee. It tends, therefore, very much to develop the leading features—the controlling features of that construction. He says: It becomes very important, both as regards comfort, safety, and economy, to devise a mode of combining the advantages derived from placing the axles at a considerable distance apart, with those of allowing them to be situated near to each other. He then refers to the attempt to overcome these difficulties by the use of coned wheels, and to the partial remedy thereby, but points out the failure of the use of those alone, under high velocity, to get rid of the embarrassment.

The patentee then explains the object of his invention, which, among other things, is to make such an adjustment or arrangement of the wheels and axles, as shall cause the body of the car or carriage to pursue a more even, direct, and safe course than it does as cars are ordinarily constructed, both over the curved and straight parts of the road, by the *desidera-*

tum of combining the advantages of the near and distant coupling of the axles, and other means which he has described.

He then describes the arrangement and construction of his car, which I will not take up your time in reading. It has been read so often, and so frequently illustrated and exemplified in the progress of this trial, that I have no doubt you are familiar with it. It will be found upon the copy of the patent which I have, between folios 24 and 28. And then comes the claim. The patentee says, after describing the construction of his car:

"I do not claim as my invention the running of cars or carriages upon eight wheels, this having been previously done; not, however, in the manner or for the purposes herein described, but merely with a view of distributing the weight carried, more evenly upon a rail or other road, and for objects distinct in character from those which I have had in view, as herein before set forth. Nor have the wheels, when thus increased in number, been so arranged or connected with each other, either by design or accident, as to accomplish this purpose. What I claim, therefore, as my invention, and for which I ask a patent, is, the before described manner of arranging and connecting the eight wheels, which constitute the two bearing carriages, with a railroad car, so as to accomplish the end proposed by the means set forth, or by any others which are analogous and dependent upon the same principles."

The claim itself explains the improvement set up by the patentee. It is the arrangement and construction and adjustment of the eight-wheeled car, as described in his specification—the car as a whole. The patentee claims no right as inventor to any of the constituent parts of the car—the wheels, the axles, the peculiar construction or framing of the running gear of the bearing carriages, the contrivances by which they are connected together, the springs, the bolsters, the turning of them upon the centre, or the swiveling of the trucks—nothing of this is claimed as new on the part of the patentee. This is plain from the terms of the claim, which is the construction and arrangement and adjustment of these various parts into a car as a whole, combining the advantages which he has set forth, as he claims.

Now, it is proper to observe, that this improvement, as claimed by the patentee, is made upon the existing four-wheel car then in general use, and which, as has appeared in the progress of this trial, is still in use in England, and, probably, upon the Continent, unless they have adopted our eight-wheel cars, some specimens of which I have understood have been sent to the Continent. It will, therefore, be proper and useful for you to examine this four-wheel car as then in general use, and the evidence in respect to it. Models have been introduced and exemplified, and no doubt you understand it. But you should inquire into this fact, in order to ascertain whether or not the difficulties described by the patentee existed upon curved roads at great velocity—I mean as respected this four-wheel car then in use upon roads with high velocity and with short curves—and whether or not the eight-wheel car, as arranged and constructed by the patentee, is an improvement upon it. This is one of the questions in the case for your consideration, and, as to this, you will probably not have much difficulty. From the time they were

first brought out in Baltimore—I mean the eight-wheel cars—it is admitted on all sides, that they have generally taken the place of the previous four-wheel car, and their use soon spread throughout the railroads of the United States, and, for aught that appears before us in this trial, the first construction and arrangement, and adaptation of those eight-wheel cars to the railroads of this country was in Baltimore, and they were constructed and arranged for the Baltimore and Ohio Railroad Company, and the Washington branch of it. It was offered, it is true, to be shown, on the part of the defendants, that one—that is, an eight-wheel car—was brought out in Massachusetts in 1838, but that fact, at that late day, affords no exception to the truth of the remark I have made: for the eight-wheel car, what is claimed by the patentee to be the perfected car, the car completed, and upon which the patent was founded, was made as early as the beginning of the winter—sometime in December, 1834—the Washington cars, some four years before the eight-wheel car in Massachusetts.

Now, gentlemen, if I have succeeded in explaining to you the improvement described in the plaintiff's patent, and claimed by him, upon these four-wheel cars, by the construction of an eight-wheel car, as I hope I have, the next question to which your attention must be called is this—whether or not this eight-wheel car, this improvement as thus described in the patent, and as first brought out in Baltimore—whether this was the improvement of the plaintiff. This is one of the material questions in the case, which, as you have already discovered, has been most seriously contested between the parties. After calling to your minds the construction given by the Court to the patent, and to what constitutes the improvement which is claimed to have been reduced to practical use—after you have ascertained and comprehended this improvement claimed by the plaintiff, and described in his patent—after this, which is a question of law, (I mean so far as the construction of the patent is concerned—) after you have ascertained what is claimed by the plaintiff as his improvement, the question whether or not he was the first inventor of it is a question of fact, which belongs to you to determine. The burden of the evidence—for the greater portion of the time, the long time which has been consumed in this trial—has been directed on both sides to the solution of this question. The patent of the plaintiff, given in evidence, and the extension of it for seven years, which has been given in evidence, together with the testimony of the experts introduced on the part of the plaintiff in the opening of the case, furnish *prima facie* evidence that the plaintiff was the first and original inventor of the improvement claimed, and of its utility; and, therefore, the burden of showing that he was not the first and original inventor, and of the inutility of the patent, rests upon the defendants. They are obliged to assume this position in that stage of the trial. Accordingly, they have gone into evidence at large for the purpose of satisfying you upon these points, and you have before you, first, the evidence from Baltimore, for the purpose of showing this—that, assuming the car described in the plaintiff's patent to be the improvement upon the four-wheel car, and that it was new and useful, yet the defendants insist upon this evidence, that the plaintiff was not the first inventor, but that somebody else was. They refer to the timber, the wood, and the trussel cars, and much evidence has

been given in respect to these cars. The plaintiff, on the contrary, insists that neither of them embodied his improvement, or that if any of them did, it was constructed after his invention, which it is claimed is carried back upon the evidence to the fall or beginning of the winter of 1830. Now, gentlemen, I am not going over this evidence on either side. It has been so amply and ably discussed by the learned counsel upon both sides, that I cannot doubt that you are familiar with every material portion of it. It will be for you to say, upon the evidence, whether or not the defendants have furnished evidence to satisfy you that the plaintiff was not the first and original inventor, but that somebody else was. They have that burden upon them. It will be for you to determine, upon the whole of the evidence, whether they have overcome the patent, and the evidence furnished in support of it.

Then another ground is taken, viz: that there is nothing new in the arrangement or construction of the car, as described in the patent, but that it was old, and before in public use; and they say that it is to be found in Chapman's patent and drawings, and also in Tredgold and Fairlamb—although, as to the two latter, they are not much relied upon—in the Quincy car, in the Allen locomotive, and in the Jervis locomotive. All these have been brought out in the progress of the trial, and amply examined and discussed, and I am persuaded that you are entirely familiar with all the evidence bearing upon this branch of the case. The question upon it will be, whether or not you find the improvement of the plaintiff—the improvement existing in the arrangement and construction of his eight-wheel car upon the four-wheel car—whether you find that improvement in any one or all of these patents or machines—not whether they have eight wheels and two trucks, free to swivel or rock—but the question is, whether the peculiar arrangement, adjustment and construction of the car—the wheels and trucks in relation to the road—claimed in the patent, and which I have endeavored to explain to you, on the principles which the patentee has developed—whether that embodiment thus found in the eight-wheel car is to be found in either of these structures to which you have been referred. That is the question.

Another ground of defence set up on the part of the defendants is, that Mr. Imlay is the inventor. You recollect his testimony, I have no doubt. It is claimed that he carries back the construction, or the idea, if not the construction, of the eight-wheel car, to 1829. It is, however, proper to say, in respect to this witness, that he spoke doubtfully as to time. He would not speak positively. It was a matter of memory with him. I noted his evidence particularly. He was uncertain as to time. But, whatever that time was, (and I refer to his interview with the Committee of the French Town Railroad,) he says he made a rough sketch of his idea of an eight-wheel car at this time, whatever time that may be, and that he made a contract with the road to build a car as he thinks, but which fell through in consequence of his partners not concurring with him; and then we hear no more of his connexion with an eight-wheel car until he removes from Baltimore to Philadelphia, in 1833, and brings out, I think, the "Victory," in 1834, or 1835, I am not certain which. I refer more particularly to the evidence of this witness, for the purpose of stating to you a principle of law. Now, the circumstance

that a person has had an idea of an improvement in his head, or has sketched it upon paper—has drawn it, and then gives it up—neglects it—does not, in judgment of law, constitute or have the effect to constitute him a first and original inventor. It is not the person who has only produced the idea, that is entitled to protection as an inventor, but the person who has embodied the idea into a practical machine, and reduced it to practical use. He who has first done that, is the inventor who is entitled to protection.

A kindred principle, also, it may be proper to state here, which is, that where a person engaged in producing some new and useful instrument or contrivance, and who has embodied it into a machine, and endeavored to reduce it to practice by experiments—if those trials fail—if he fail in success and abandon it, or give it up, that consideration affords no impediment to another person, who has taken up the same idea or class of ideas, and who has gone on perseveringly in his studies, trials, and experiments, until he has perfected the new idea, and brought it into practical and useful operation. He is the person—the meritorious inventor—who is entitled to the protection of the law.

Another ground of defence set up is, that the patentee allowed the public use of his improvement, of his eight-wheel car, upon the Baltimore and Ohio Railroad, before he made his application for a patent. Now, it is undoubtedly true, as the law stood at the time of this patent, in October, 1834, that the public use of the invention, with the consent of the patentee, or sale of it, prior to the time of his application for a patent, operated as a forfeiture—as a dedication to the public. This, however, means the use of the perfected invention—the invention complete. If the use be experimental, to ascertain the value, or the utility, or the success of the thing invented, by putting it into practice by trial, such use will not deprive the patentee of his right to the product of his genius. The plaintiff, therefore, in this case, had a right to use his cars on the Baltimore and Ohio Railroad, by way of trial and experiment, and to enter into stipulations with the Directors of the road for this purpose, without any forfeiture of his rights. He could not probably obtain the opportunity of trial which was essential to the perfection of his improvement without obtaining their consent, and, as I have already said, it is the use of the improvement after it has been completed and reduced to practical success, which operates as a forfeiture—as a dedication to the public—as a giving it up to the public.

Now, gentlemen, if upon consideration of these questions which I have submitted to you, you should come to the conclusion that this improvement is a useful one, and that the plaintiff is the first and original inventor of it, the next question for your consideration is, the question of infringement. If you are against the plaintiff upon either of the two first questions—of utility and originality—then, of course, this other question will not be reached.

Then, as to the infringement by the defendants' cars, the question is—do they embody the arrangement and construction of the plaintiff's car—in other words, the improvement in the plaintiff's specification? Improvements, as you have seen during the progress of this trial, have been made upon the eight-wheel car, since it was brought out and put in

operation. The swinging bolster is an instance, and there are also others that have been mentioned in the course of the trial. Now, the improvements thus made upon the eight-wheel car do not give any right to the thing improved. The plaintiff in this case would have had no right to use a four-wheel car if there had been a patent for it, because he had improved it by the eight-wheel car. So an improvement upon the eight-wheel car does not absorb, or give a right to the inventor of that improvement to use the thing improved. Therefore, the question still is whether or not you find in the defendants' organization and arrangement the organization and arrangement of the plaintiff's improved car. If you do, the additional improvements since made upon it do not disprove the infringement. It is a question of fact for you to determine. Having ascertained and comprehended what the improvement of the plaintiff is, as claimed in his patent, and which I have endeavored to explain to you in the beginning of this charge, you will apply that to the defendants' cars, and see whether it is embodied there. If it is not, then there is no infringement. If it is, there is an infringement.

Then, as to the question of damages. It is admitted by the counsel for the plaintiff that the amount stated in the declaration is \$10,000: This suit was brought on the 16th of January, 1849, as stated. They claim damages for the years 1847 and 1848. It is in evidence that 24 eight-wheel passenger cars, 32 freight cars, and 8 baggage cars were used in 1847 by the defendants upon their road; and in 1848, 25 eight-wheel passenger cars, 35 freight cars, and 11 baggage cars. It is also in evidence, and it does not seem to be contradicted, that the patent fee for the right to use an eight-wheel passenger car, is worth \$200 a car per annum for license, and that the freight cars and baggage cars would be worth \$20 per annum. Taking this evidence, and there seems to be no contradiction about it, the damages claimed, upon the principle which I have stated, would exceed considerably \$10,000. There is no doubt about that. But you are limited, and you cannot go beyond that sum.

These, gentlemen, are all the observations I think it is necessary to make to you.

I have prayers for instructions here, by the defendants' counsel, numbering, I believe, eighty, but the counsel must excuse me from going over them. I have given all the instructions, and all the principles of law that I deem necessary or useful in the submission of this case to you, and whatever may be found in these numerous prayers is beyond what I deem proper to trouble you with, for I regard them as not pertinent, nor relevant, and not material to comment upon.

The jury not being able to agree upon a verdict, were discharged.

MECHANICS, PHYSICS, AND CHEMISTRY.

For the Journal of the Franklin Institute.

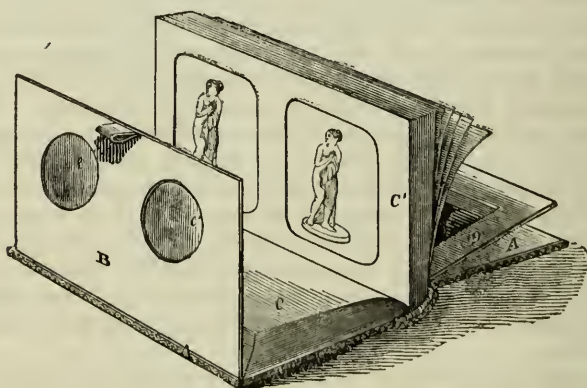
Mascher's Book Stereoscope.

The accompanying engraving, presents a view of an additional improvement in stereoscopes, for which letters patent were granted Feb-

ruary 18, 1856, to Mr. J. F. Mascher, of this City, the inventor of the "Stereoscopic Daguerreotype Case."

This stereoscope consists of a book, in which the stereoscopic photographic pictures are permanently bound. A supplementary lid, containing the two lenses, is attached to the outer edge of one of the lids of the book, and a "supplementary back," or perforated mat, is attached to the inner edge of the back of the book.

The object of the several parts will be more readily understood, by having reference to the engraving. *A A*, are the two lids (or shells) of the book. *B*, is the "supplementary flap," containing the two ordinary convex lenses *b b*, through which the two stereoscopic pictures are viewed, which latter are, by binocular vision, converted into one picture, possessing the well known characteristic relief. This flap is folded, when not in use, within the book, which latter, when closed, cannot be distinguished from an ordinary book. *c c*, are the leaves composing the book, upon which, are photographic or engraved pictures. These leaves are no thicker than ordinary printing paper of good quality, and a gross or more of such pictures may be bound in a book of ordinary size and thickness.



The book now before us, has blank leaves interposed between the pictures, which are designed for written descriptions of each picture. Printed descriptions would evidently answer a still better purpose.

A large number of blank leaves are bound in the back portion of the book, which are intended to be cut out for the purpose of allowing new pictures to be pasted in their stead, as they may be published from time to time; being, in this respect, similar to a scrap-book.

D, represents the perforated mat, furnished with gum elastic straps (not shown in the engraving), into which ordinary stereoscopic pictures, either Daguerreotype, albumen pictures upon glass, or the common paper pictures pasted upon card-boards, may be temporarily slid, for the purpose of being viewed through the aforesaid lenses, *b b*. This is a very simple arrangement, which enables the book to be used, not only as a stereoscopic book *per se*, but also as a common stereoscope. Indeed, the inventor has some of these books for sale, called by him "Skeleton Book

Stereoscopes," which he sells for 37½ cents each, in which the leaves are entirely absent. Again, stereoscopic or non-stereoscopic books can be constructed, in which the paper pictures are entirely substituted by a number of these supplementary backs, into which daguerreotype or other pictures are permanently fastened. In this manner a daguerreotype case (book) may be made capable of holding a dozen or more likenesses.

From the above brief description, it is presumed that the arrangement of the book will be understood. We will now merely make a few remarks as to the objects to which the book may be applied.

By the employment of a peculiar lens, invented by the patentee, named by him the "Prismatic Lens," stereoscope books can be made of any size, even as large as a quarto-volume.

Again, by the employment of the principles embraced in the Stereoscopic Locket, illustrated upon page 215, Vol. xxix., of this *Journal*, (also by this patentee,) books can be made of the smallest size. They can be made so small that they can be carried in the pocket, or of a large and handsome size, suitable for an ornament for the centre-table.

They may be used as picture books exclusively, or works of biography, natural history, voyages and travels, mechanics, &c., &c., in which the ordinary wood-cuts are replaced by beautiful photographic stereoscopic pictures. Or, if the latter should be deemed too expensive, the stereoscopic pictures may be engraved in outline upon wood, which then, with the exception of the first cost of the engraving, will not cost more than the ordinary wood-cuts. That the latter may be done, is proved by the well known "Wheatstone diagrams." The patentee is now making a series of experiments, with a view of facilitating the engraving of stereoscopic pictures on wood. Photographic pictures are taken on wood, from which the engraving is directly executed in outline—in outline, because it is well known that to engrave in lights and shades, is one of the most difficult things to do, if not impossible; whereas, outline engravings are comparatively easy of execution. With these outline engravings, it is proposed to illustrate works on mechanics, &c., which it is believed will be not only perfectly feasible, but will be attended with only a small additional cost; and where is the machinist that does not know the advantage of having a *model* instead of a mere drawing, to look at? An ordinary drawing gives surface only, whereas a stereoscopic drawing gives surface and depth.

The book before us contains twelve beautiful interior and exterior views of the late French Crystal Palace, printed by the well known artists, *Richards & Betts*, as well as some portraits of eminent statesmen and actors. The book with pictures, all complete, will cost about \$ 3.50, or less than what the pictures were sold for prior to his invention, or about the same price for which a good stereoscope without the pictures, could formerly be bought.

For any further information relative to a supply either of books, separate pictures, or the sale of patent rights for any particular publication, address the patentee, John F. Mascher, No. 408, north Second street, Philadelphia.

M.

For the Journal of the Franklin Institute.

On Gas Furnaces. By CHARLES SCHINZ.

(Continued from page 274.)

In a first article, we have shown that one pound of anthracite is capable of producing 14,780 units of heat, and a temperature of 4956° Fah.; but at the same time are traced some of the reasons why this theoretical result is not attained in practice.

The quantity of heat as above estimated, in fact, may be produced, but only when double the amount of air is introduced to the fuel, and, as before stated, in that case, a large quantity of heat is lost.

In England and the United States, where fuel is cheap and plentiful, economy in its consumption is not an object of so great importance as in France and Germany, where, in most localities, the price of fuel is twice as great. Necessity, therefore, has in the latter two countries, called the attention of chemists and engineers to this point, and they have successively improved the construction of furnaces; indeed, to such a degree, that the theoretical effect obtainable from the fuel may be brought forth, not only from well prepared fuels, but also from inferior fuel of any kind.

The principle upon which this result is practically attained, is fully correct, and theoretically consists in the preliminary transformation of the fuel into gas, and burning the latter in a separate place, by the introduction of exactly the air required.

According to the quantity and the size of the fuel, a stratum of $2\frac{1}{2}$ to 4 feet thickness, will produce from all the carbon contained in the fuel only carbonic oxide. The fuel composing the upper stratum of the fire, is sufficiently decomposed before it is consumed, to give off all the hydrogen, both combined with oxygen and carbon, and these compounds pass off with the carbonic oxide; carburet of hydrogen and carbonic oxide being burnt when they meet the supply of air.

If these gases are all burnt, and the fuel thus converted into carbonic acid and water, it is evident all the heat has been produced it was capable of, and if the two quantities of air, that which was used to form the gas, and that used to burn it, have been properly divided, the greatest intensity has also been obtained. To do this is, or was, the practical difficulty which existed in the use of gas furnaces.

This difficulty would not exist, if both portions of air had to be introduced under the same pressure, but to produce a complete mixture of the air, and consequently complete combustion with the former, it is necessary to give them very different velocities. The difficulty is further increased, by the use of hot air instead of cold air to effect the combination of the gases, and this substitution, though not absolutely necessary, is yet highly commendable for different reasons.

I will proceed now to give a general idea of the construction and operation of a self-regulating gas furnace, for which I obtained a patent from the Government of the United States, dated December 4th, 1855, and which brings gas furnaces to a perfection hitherto unattainable.

Fig. 1, represents a vertical section of the gas furnace as seen from the front.

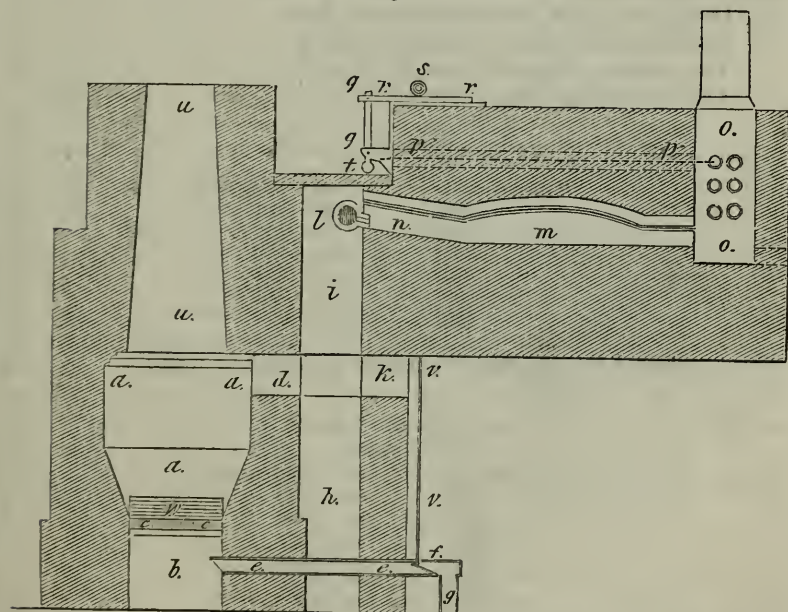
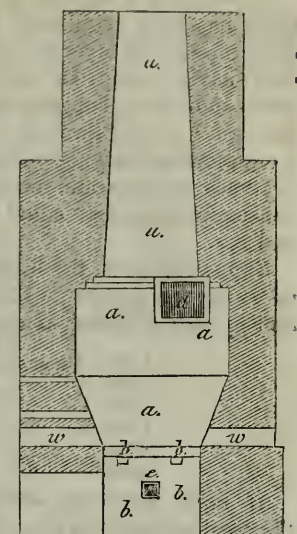
Fig. 2. A vertical section through the length, showing the generator, the heating furnace, and the contrivance for heating the air by the waste heat.

a, a, represents the fire place filled with fuel. *u, u*, the flue through which the fuel is introduced; it is closed above, and only open to feed; *c, c*, represents a grate. *b, b*, the ash pit. *e, e*, the air flue by which the cold air is introduced to the fuel. *g*, a pipe connecting *e, e* with the blower. *d, d*, flue through which pass the gases generated in *a, a*. *h*, a pit collecting ashes and other impurities blown off with the gas. *k*, a short flue giving access for cleaning, &c. *i*, a perpendicular flue out of which the gas flows round the tuyeres *l* into the flue *n*. *m*, represents the heating furnace. *o, o*, the air heater; it consists of two sets of flues, each set has three flues, is connected with the main wind-pipe, and each brings the heated air by two separate pipes to the tuyeres *l*.

The tuyeres *l*, issue from one main pipe connected at both ends with

Fig. 2.

Fig. 1.



the air heater; the tuyeres properly are short conical tubes, which entered into the flue *n*, thus sending the heated air with velocity, and mix it with

the gas flowing from *i*. *w, w*, are flues for the purpose of cleaning the grate and tending the fire.

The tuyeres *l*, and the flue *e, e*, are therefore the points where the flow of air has to be regulated. Supposing now, the pressure of the air in the main pipe of the tuyeres *l*, and in the pipe *g*, to be the same, and the tuyeres *l* having a constant section, we may by the valve *f*, and by means of water indicators, contrive to introduce exactly the same quantities of air through *e, e*, and through *l*. But the air contained in *l*, being heated to a temperature varying between 300 and 600° Fah., the pressure then becomes much greater than in *g*; this produces a reaction upon *g*, and the consequence is, that equal volumes, but not equal weight, go through *l* and *e, e*.

Supposing now, the blower furnishes every second 2 cubic feet of air, of which one should go through *e, e*, and one through *l*. This one cubic foot by being heated, is expanded into

1.224	Cubic feet of the	temperature of	142° Fah.
1.448	"	"	252° "
1.672	"	"	362° "
1.896	"	"	472° "
2.120	"	"	582° "
2.344	"	"	692° "

If now, there are seven tuyeres issuing from *l*, each of one inch, the total area of the seven tuyeres is 5.4978 square inches; but, on account of the contraction the air undergoes, in passing through such tuyeres, this area is reduced to $5.4978 \times 0.94 = 5.167932$ square inches = 0.03588 square feet.

Designating now, this constant area by *s*.

The volume of air to go through it by *q*.

The velocity of the air through it by *v*.

And the pressure for effecting this by *h*,

$$\text{we have } \frac{q}{s} = v.$$

Hence <i>v</i> at 32°	=	27.9 feet.
" 142°	=	34.1 "
" 252°	=	40.3 "
" 362°	=	46.6 "
" 472°	=	52.8 "
" 582°	=	59.1 "
" 692°	=	65.3 "

$$\text{then } h = \frac{v^2}{64.3} \text{ and } h' \text{ pressure in inches of water}$$

$$= \frac{v^2}{64.3 \cdot 0.0013} \times 12$$

<i>h'</i> at 32°	=	0.188 inches.
" 142°	=	0.282 "
" 252°	=	0.391 "
" 362°	=	0.527 "
" 472°	=	0.677 "
" 582°	=	0.846 "
" 692°	=	1.035 "

These variations of pressure, of course, must be felt at *g* and *e, e*, and

if the area of e, e , is made to vary with the pressure, the consequence is, that a much greater weight goes through e, e , than through l .

What are now the areas to be given to e, e , by the valve f , for these pressures? Let s' be this variable area. q , is a constant quantity equal to one cubic foot. v in the function of h is the same as above, therefore,

the area for each case is represented by the formula $\frac{q}{v} = s'$.

Hence when the temperature at $l =$	32°	$s' = 5.168$	square inches.
"	142°	$s' = 4.222$	"
"	252°	$s' = 3.568$	"
"	362°	$s' = 3.091$	"
"	472°	$s' = 2.726$	"
"	582°	$s' = 2.438$	"
"	692°	$s' = 2.205$	"

Supposing now, the square flue e, e , to measure inside four inches each way, the valve has to be lifted from the bottom,

2.508	inches to produce the area of	5.168	square inches.
2.945	"	4.222	"
3.108	"	3.568	"
3.227	"	3.091	"
3.319	"	2.726	"
3.391	"	2.438	"
3.049	"	2.205	"

Now, it is easy to lift the valve with accuracy, to the height required for each case, but the difficulty is, to know the expansion or the temperature of the air at l . A thermometer might perhaps indicate this, but, as the temperature varies very often, it would require the attendance of one man to regulate the valve. Hitherto, the quantity of cold air supplied to the fuel, has been regulated by the judgment of a workman, and this has been the practical difficulty in the use of gas furnaces.

A contrivance, therefore, which of itself regulates the supply of air, may be said to bring gas furnaces to perfection.

The self-regulator acts as follows: A metallic bar of such metal as expands largely when heated, as for instance, copper, is fixed in one of the pipes conducting the heated air to the tuyeres l ; it is represented in Fig. 2 by the dotted line pp ; it extends a little further than the pipe, and strikes against the lever qq , on which below a ball t is appended, giving it a tendency to remain in a perpendicular position. Connected with the lever qq , is the rack rr , and upon this is placed the cog-wheels s . When the bar pp is expanded, as it does proportionally with the increase of temperature around it, the lever qq is moved from its perpendicular position, motion is communicated to rr , and then to the wheel s . On the axle which supports the wheel s , are the eccentrics, and as s revolves, the bar vv is raised, and with it the valve f .

Supposing the copper bar pp to be ten feet long inside of the hot-air pipe, its expansion is

0.000	inches at	32°
0.126	"	142°
0.257	"	252°
0.393	"	362°
0.533	"	472°
0.678	"	582°
0.828	"	692°

As the lever is moved from its perpendicular, an angle, contained

between it and a line drawn to represent its original position, is formed, and the sine of this angle measures the expansion of the bar when the distance from the centre of the fulcrum is exactly one inch.

Seeking the angles corresponding to the different expansions, we have

Sine	0.126	=	7° 45''
"	0.257	=	10° 30''
"	0.393	=	14° 20''
"	0.533	=	20° 00''
"	0.678	=	28° 30''
"	0.828	=	42° 20''

The wheel *s* is made of such a diameter, as to perform one revolution for the expansion of the copper bar *pp*, from 0 to 0.828 inches. If now, we divide the circle *s* into $42\frac{2}{3}$ parts, it is apparent that each one of these parts corresponds to one degree of the angle made at the fulcrum by the lever with the perpendicular.

Having these data, the eccentric transferring the motion to the valve *f*, may be constructed as follows: divide the circumference of a circle of any diameter into $42\frac{2}{3}$ equal parts, take a point to start from, and at the distance of $74\frac{5}{6}$ of these parts; from this point, draw a radius; at a distance of $10\frac{3}{4}$ of these parts, from the same point draw another radius, and so on with the rest. On these radii mark off distances corresponding to the different heights to which the valve has to be raised, connect these marks by a curved line, and the result is the eccentric required.

It is evident that an eccentric so constructed, will cause the valve to rise or fall with the slightest variation of the temperature of the copper bar.

In the above calculations, we have supposed that equal weights of air had to be introduced through *e* and *l*. This is the case when the fuel used contains no free hydrogen, as, for instance, charcoal or coke. If, however, the fuel contains free hydrogen, allowance must be made, and a larger proportion of air be injected at *l*.

Every possible kind of fuel may be used successfully in these gas furnaces, though their construction varies with its nature and quality.

We remarked above, that though it was not absolutely necessary to burn the gases with air previously heated, yet it was commendable. We will examine this further. One pound of anthracite converted into gas yields 3747 units of heat, and the gas is composed of

Oxide of Carbon,	.	.	.	.	.	2.135 lbs.
Water (steam,)	.	.	.	.	.	0.219 "
Nitrogen,	.	.	.	.	.	4.737 "

The specific heat of these gases is respectively :

$$\begin{array}{rcl}
 \text{lbs.} & & \\
 2.135 \times 0.2479 & = & 0.529, \\
 0.219 \times 0.4750 & = & 0.104, \\
 4.737 \times 0.2440 & = & 1.156,
 \end{array}
 \left. \vphantom{\begin{array}{rcl} 2.135 \times 0.2479 & = & 0.529, \\ 0.219 \times 0.4750 & = & 0.104, \\ 4.737 \times 0.2440 & = & 1.156, \end{array}} \right\} 1.789.$$

Hence the temperature that results from converting the fuel into gas

$$= \frac{3747}{1.789} = 2094^\circ \text{ Fahrenheit.}$$

If, now, the gases are mixed with an equal quantity of cold air, viz:—

11.456 lbs., having the specific heat of $11.456 \times 0.2377 = 2.667$, the temperature of the mixture becomes

$$\frac{3747}{1789 \times 2667} = 841^{\circ} \text{ Fahrenheit, a temperature very}$$

low indeed, and this temperature is still lessened, when, as is sometimes the case, the gases have to be conducted some distance to be burnt.

Another reason for the use of heated air is, that the intensity of the fire is greatly increased; for instance, the temperature obtained by the perfect combustion of anthracite, as shown in Table VII., = 4956° Fahr., of which 2094° Fahrenheit is obtained in the formation of the gases, and 2862° is produced by their combustion, and since the temperature of the blast at the tuyeres is 600° , we have the additional heat of 300° Fahrenheit. The intensity, therefore, = $2094^{\circ} + 2862^{\circ} + 300^{\circ} = 5256^{\circ}$ F.; a temperature which ranges amongst the highest ever observed, and one high enough for all metallurgic operations, as is apparent, when we consider that

Copper melts at	.	.	.	.	.	.	2012° Fahr.
Gold	"	.	.	.	.	.	2282°
Cast Iron	"	from 2372° to	.	.	.	.	2552°
Soft French Wrought Iron melts at	.	.	.	.	.	.	2732°
English Wrought Iron	"	.	.	.	.	.	2912° *

In metallurgic operations, an intense heat is the most economical for two reasons: 1st, The time; it requires less time to bring the body to be heated to the required temperature; and, 2nd, because the transmission of heat is nearly proportional to the square of the difference between the heating and the heated bodies. Too much importance can scarcely be given to this last fact, and it is as unfortunate as true, that many persons are entirely ignorant of it. The self-regulating gas furnace, from the intensity of the heat it produces, may be safely recommended for all smelting processes, distillation of zinc, heating and puddling of iron, cobalt, and the smelting of glass. It removes many difficulties, hitherto inseparable from all fires and furnaces; 1st, and most important, it, of itself, introduces the exact amount of air-necessary for the combustion of the gases, thus complying with the chief requirement of the theory for producing the greatest amount of heat from fuel; 2d, the draft is constant; 3d, the draft is entirely within the operator's control, and 4th, it possesses many little mechanical contrivances, not given in the drawing, viz: the use or disuse of a grate as required, and in the latter case, the removing of the ashes without trouble, the feeding

* These figures appear to me the most reliable. It is amusing to observe how authors have copied from one another in representing the temperatures obtainable in furnaces; thus introducing many blunders into science. So we read,

Temperature of a china furnace from 11,000 to 12,000° Fahrenheit.	} Knopp.
" " Gas furnace,	
Melting point of cast iron,	
	9,388° " }
	17,977° " }

Whereas, at the present day, it has been accurately demonstrated, and is a settled fact, that no fire, produced by atmospheric air, can yield a heat more intense than 5000 and some hundred degrees.

For the Journal of the Franklin Institute.

Particulars of the Steamer James A. Requa.

Hull built by Harlan & Hollingsworth, Wilmington, Delaware. Intended service, New Grenada.

HULL.—

Length on deck, ...	214 feet.
“ “ between perpendiculars, ...	210 “
Breadth of beam, ...	32 “
Depth of hold, ...	7 “
“ “ to spar deck, ...	7 “
Load draft, ...	2 “ 6 inches.
Tonnage, ...	450.
Area of immersed section at load draft, ...	70 “

ENGINES.—Inclined direct non-condensing.

Diameter of cylinder, ...	24 inches.
Length of stroke, ...	8 feet.
Weight of engines and wheels, ...	210,000 lbs.

BOILERS.—Five—Cylindrical—flued.

Length of boilers, ...	35 feet.
Breadth “	3 “ 6 inches.
Weight of “ without water, ...	120,000 lbs.
Load on safety valve, per square inch, ...	140 lbs.
Number of furnaces, ...	5.
Breadth of “	(?) 18 “ 6 “
Length of grate bars, ...	6 “
Number of flues, ...	10.
Internal diameter of flues, ...	15 “
Length of flues, ...	34 “
Heating surface, ...	2400 sq. ft.
Diameter of chimney, ...	5 “
Height “	50 “ 9 “

PADDLE WHEELS.—

Diameter over boards, ...	26 feet.
Length of “	8 “
Depth “	15 inches.
Number “	19.

Remarks.—Frames, shape L, 3 ins. × 3 ins. × $\frac{3}{8}$ in. and 24 ins. apart. Number of strakes of plates from keel to gunwales, 11. Thickness of plates $\frac{3}{8}$ – $\frac{5}{16}$ and $\frac{1}{4}$ in. Number of bulkheads, 3. Diameter of rivets, $\frac{5}{8}$ ths. Distance apart, 2 ins.; single riveted. Depth of keel, 4 ins. Independent steam, fire, and bilge pump, 1. Has 11 athwartship frames, and 8 side keelsons 12 ins. deep.
C. H. H.

For the Journal of the Franklin Institute.

“Improved Double-Action Force Pump.” By ERSKINE HAZARD.

I was much surprised, on reading the article at page 32, of the *Journal of the Franklin Institute*, for January last, that none of the Committee on Publications gave our countryman, Jacob Perkins, Esq., the credit of inventing the double-stroke force pump, claimed by Robert Aytoun. It is precisely his single barrel fire and garden engine pump, which was

manufactured by him in great numbers in this City, some thirty-five years ago; and afterwards by his successors, Merrick & Agnew. In those engines, an external cylinder, surrounding, and communicating with the top of the pump barrel, by numerous holes, formed the "bent pipe," leading to the air vessel. If I am not mistaken, I have, some years since, seen the same principle applied to common lifting pumps at Carbondale, a thick pump-rod acting like a plunger, in keeping up a continuous discharge.

On Working Steam Expansively in Marine Engines. By Mr. E. ALLEN.*

(Continued from page 256.)

In the foregoing paper, the object of the author has been merely to collect a few particulars of the different classes of vessels, and to give a rough approximation to the effects which would be produced by a certain saving in fuel, even did no alternative exist but that of increasing the size and weight of the engines.

There does not appear to be much doubt about a *saving in fuel*, even of 40 per cent., being made by *expansive working*, considering what is now the general average consumption.

If the present ordinary consumption be taken at $4\frac{1}{2}$ lbs. of coal per indicated horse-power, a saving of 40 per cent. would reduce it to $2\frac{3}{4}$ lbs. per horse-power, and this quantity will appear ample, when it is considered that many land engines are working with $2\frac{1}{4}$ lbs. per indicated horse-power.

The pressure of steam assumed in the foregoing calculations of the saving of coal, where different sized engines are employed, has been only 20 lbs. above the atmosphere. A very much larger saving would, however, result, if steam of a higher pressure were used. The principle upon which the engines are supposed to be altered, is that of increasing the diameter of an ordinary cylinder, presuming the stroke to remain the same.

As the interests of marine engineers and steam-ship builders must, in the long run, be identical with those of the merchants or companies employing them, it is clearly of the utmost importance to endeavor by every means to economize fuel. Little, however, can be hoped for so long as the merchant determinately refuses to pay for that economy in some shape or other. It is not to be expected that engineers will supply larger engines than custom necessitates, and for which they obtain no additional payment; nor will they exercise their talents to economize in that direction which appears least appreciated.

Considerable competition has for a long time existed amongst engineers for the purpose of reducing the space occupied by engines, but this has been done without reference to the question of economy in total space of machinery and coal, or without reference to economy in consumption of fuel.

This competition has been, nevertheless, productive of much good,

* From the Lond. Mechanics' Mag., Aug., 1855.

as reduction in weight and space occupied by engines is of the utmost importance, other things remaining the same.

It is believed, however, that when the subject is better understood by merchants than it appears to be at the present time, they will no longer refuse to purchase the economy when offered to them.

Were the Government now to throw open a contract, where *economy in fuel* was the object sought, in the same manner as they did some years ago, when *economy in space and weight* were the objects, we might look for the same or greater benefits than then resulted from so advisable a plan.

The author has now to show in what manner he believes nearly all the advantages enumerated in the foregoing Tables can be obtained, by a peculiarly constructed engine of his invention, adapted for the *expansive use of steam*, without those disadvantages which have doubtless prevented the more general adoption of the principle of expansion in marine engines, viz: the increased size, weight, and cost of the engines.

The degree of expansion to which it is necessary to work, in order to obtain great economy, would seem to require an arrangement of engines different from the ordinary one, inasmuch as the great variation of pressure from the beginning to the end of the stroke, would cause considerable irregularity in the working of an engine where no fly-wheel can be employed. Added to this objection, there is also another of equal importance—the necessity of making all parts of the engine (where a single cylinder of large capacity is used for expansive working), strong enough to resist the greatest strain to which they are subject, namely, that at the commencement of the stroke, the weight and cost of engine rising also in a corresponding degree with its strength. In order, therefore, to overcome these objections, and adapt it for marine purposes, it seems necessary that an engine should be arranged on the following principles:

1st. That the steam on its first entrance should act upon a comparatively small area.

2d. That it should finally expand to a considerable extent, the limit being determined by the friction of the machinery and the pressure of uncondensed vapor in the condenser.

3d. That the variation in total pressure from the beginning to the end of the stroke should be as small as possible for any given expansion.

4th. That the work done by the in and out strokes (that is, of a horizontal screw engine) should be equal, or as nearly so as possible.

5th. That the horizontal or floor space occupied, should be as small as possible—the height not being of great importance, if within say 6 or 8 feet.

6th. That the strain upon all parts of the engine should be as nearly uniform as possible, and not concentrated at any portion of the stroke.

7th. That the steam, from its entrance to its exit, should work against a vacuum, if possible.

The arrangements shown in the accompanying engravings, meet to a considerable extent, the above conditions. They are all upon the *double expansive principle*, and therefore may be said to work with both high and low pressure steam.

Figs. 1 and 2, show an arrangement in which the high pressure steam enters into the upper part of the cylinder, and presses upon the *annular*

Fig. 1.

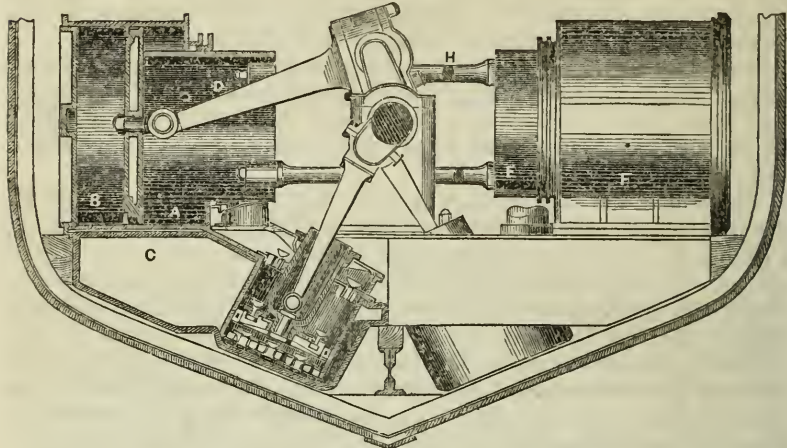
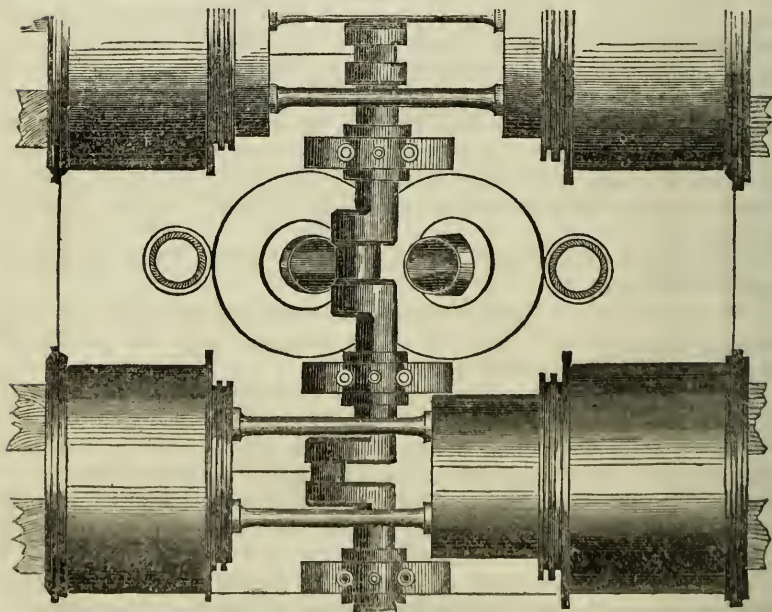


Fig. 2.



space A A, round the trunk—this being comparatively a small surface—it is cut off at $\frac{1}{4}$ or $\frac{1}{2}$ of the stroke, according to circumstances, and then is passed to the lower part B of the cylinder, in which it is expanded to the extent required, this being in the ratio of the annular space to the whole area of cylinder. During the time the high pressure steam is acting on the annular space A A, the lower part B of the same cylinder is

open to the condenser *c*, and while the steam is expanding on the lower part of the cylinder, on an area equal to that of the trunk *d*, a vacuum is maintained in the bottom of the *opposite* cylinder *f*, and so admits of the greatest degree of expansion. The trunks *d e*, of the two opposite cylinders, being firmly connected together by the rods *h h*, causes the pistons of both cylinders to move simultaneously, and the gross power exerted in each direction is made up of the pressure of the high-pressure steam in one cylinder, and the expanding steam in the other or opposite cylinder. The trunks are for the purpose of shortening up the engines as much as possible.

The main features in this arrangement are, first, that the atmospheric pressure on the outer end of the trunk is counterbalanced, which, if not done, would prevent the steam being worked so expansively, as the pressure of the atmosphere on the trunk would be added to the pressure of the high-pressure steam which is not required, and would have to be balanced by the expanding steam, which (in order to maintain an effective moving power) could not then be expanded to the same extent; and, secondly, that the high-pressure steam acts only upon a comparatively small area.

Fig. 3.

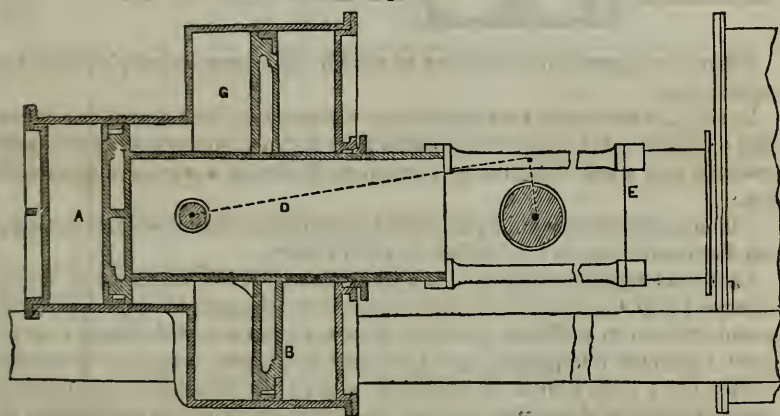
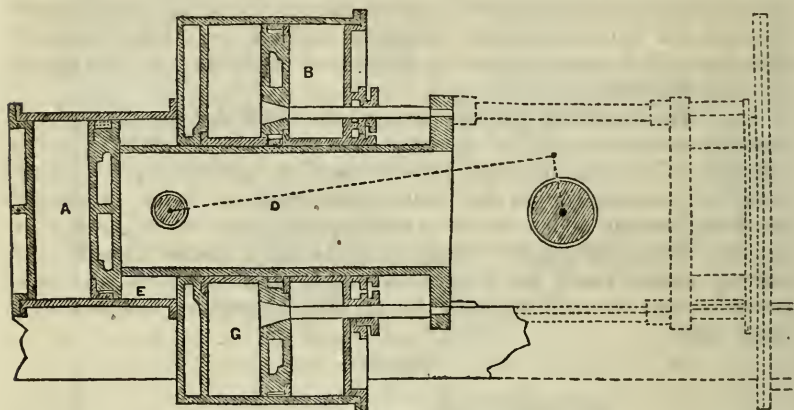


Fig. 3, shows an arrangement by which an objection to a large trunk could be overcome. This plan is much the same as Sims' arrangement, only having a trunk *d*, attached to the pistons for economizing space, a vacuum is here maintained *constantly* in the space *g g*, between the two pistons; the high-pressure steam acting on the bottom of the small piston at *a*, and afterwards expanding in the annular space *b b*. The trunks *d e*, being small in this case, the same necessity would not exist for combining opposite trunks together, though in the event of the power being large and four cylinders employed, an evident advantage would follow.

Fig. 4, shows an arrangement by which an engine, on the above plan, could be made double-acting, that is, having high-pressure steam admitted on *both* sides of the small piston at *a* and *e e* alternately, and using *both* sides of the large piston *b b* and *g g* alternately for expansion. This is done in the way shown—the cylinders being distinct, and the trunk *d*,

being encased as it were by a tube through the large cylinder—thus avoiding any internal stuffing box. In this arrangement the large piston is an *annular* one, and the junction between the two pistons is made *externally* by two or more piston-rods *FF*, being attached to the large piston and to the trunk.

Fig. 4.



There are several other forms in which the same principles may be carried out.

In fig. 1, where only two cylinders are required, the atmospheric pressure on the trunk may be counterbalanced by an opposite *piston* or *trunk* working in a fixed cylinder or condenser having a vacuum maintained in it.

The modifications would all depend upon the particular objects sought, and the conditions to be fulfilled in each case.

After the reading of the paper, the Chairman (Mr. W. Fairbairn, F.R.S.) observed that the subject of the further development of the expansive principle, in the different forms of steam engines, had become one of great practical importance, and had been at present only very partially carried out; they were most probably only on the threshold of extensive improvements in the steam engine, and particularly in the application of the expansive principle, combined with higher pressures than had been hitherto generally used. The degree of expansion of the steam was seldom carried at present beyond about three times, but he thought it might be carried up before long to ten times, or even higher, the important economy of which had been so ably shown in the paper read by Mr. Allen. To carry this out thoroughly, so as to obtain the full commercial benefit of the economy that was practicable, a considerably higher pressure of steam in the boilers would be requisite than was at present generally made use of; the pressure in the marine and land condensing engines had been already increased very generally from the old limit of 6 lbs. or 7 lbs. above the atmosphere to about 20 lbs. per square inch; and in the Cornish engines to 40 lbs. or 45 lbs.; but it did not appear impossible that this might be ultimately increased even to 100 lbs., or 120 lbs., as was constantly used in locomotive engines.

(To be Continued.)

For the Journal of the Franklin Institute.

United States Mail Steamer Fulton. By ERASTUS W. SMITH, Resident Engineer to the "New York and Havre Steam Ship Company."

(WITH A PLATE.)

Vessel built by Smith & Dimon, under the superintendence of Captain William Skiddy. Engines by the Morgan Iron Works. George Quintard, Proprietor.

DIMENSIONS.—

Length on deck, ...	290 feet.
Breadth of beam, ...	42 " 4 inches.
" over all, ...	65 " 6 "
Depth of hold, ...	31 " 6 "
Tonnage, custom house, 2300.	
" carpenter's measurement, 3000.	
Diameter of cylinders, ...	65 "
Length of stroke, ...	10 "
Diameter of paddle wheels, ...	31 "
Length of paddles, ...	9 "
Number of " in each wheel, 28	
Width of "	18 "
Shafts of wrought iron.	
Diameter of crank journal, ...	18½ "

BOILERS.—Two of iron, with vertical brass tubes, one boiler forward of the engines, the other aft.

Length of boiler, ...	12 feet.
Width "	30 "
Height " exclusive of steam chimney, 14	"
" " inclusive " " 26	"
" of smoke chimney above " " 40	"
Diameter of " " 6	"
Total amount of fire and heating surface, 9100	square feet.
" " grate surface, 343	"
Number of furnaces in each boiler, 7.	
Draft " Natural.	
Length of grates, ...	7 feet.
Description of coal.—Outward passage, Anthracite.	
Homeward " Bituminous.	
Maximum pressure of steam to square inch, 25 pounds.	

Remarks.—The *Fulton* has three decks, the upper or spar deck being "flush" and surrounded with galvanized iron netting. Pilot houses, rooms for the cooking galleys, butcher, baker, and pastry cook; a few officers' rooms, entrance to cabins and the machinery, are the only joiner work incumbance on the spar deck.

Forward, is Captain Skiddy's (Brown's patent) anchor capstan, bitts and deck stoppers, by which thirty-two feet of cable are hove in per minute. They are a great improvement over the old windlass arrangement, and merit the especial attention of the inspectors for the Underwriters. The next important feature forward, is the pilot or steering house, where the helmsman can see as well, and as soon, any danger ahead, as the forward watch; and shift the helm immediately, without waiting for the word to be passed aft. There is, in addition, a second or reserve steering wheel, in the usual place aft.

There are three double acting hand fire engines on deck, with 600 feet of fire hose. There are also provided, eight life-boats, six of iron,

(Francis's patent,) two of wood. Every boat is furnished with water, provisions, sails, oars, &c., and on sailing, the passengers are numbered for each boat. Every boat is officered and manned, the officer's rank being painted on her; and there are regular station bills throughout the ship, appointing every one of the crew to their places in case of fire or collision.

Below the spar deck, on the main or "berth deck," we have the dining saloon, sleeping rooms, ventilating and lighting galleries, skylights, polished tables, beautifully veneered and polished portheads, ladies' saloon and boudoir, pantries, steam table, second cabin dining saloon, with sleeping rooms forward, all on the same general plan and style as those of the steamer *Arago*.

The *Fulton* can accommodate 300 passengers, carry 800 tons of coal and 700 tons of freight, with a draft of water of 17 feet 6 inches. The frames at bottom are of oak, with long filling-in, floor timbers of oak, making the floor solid the entire length of ship. Frames at keel, moulded 17 inches; sided 16 inches; distance between centres 32 inches. Frames from floor heads to clamps on spar deck, strengthened by diagonal iron truss work, composed of bars $4\frac{1}{2} \times \frac{3}{4}$ -inches, cross laid at angles of 45° , riveted together at their intersections with each other, and each bar bolted to every frame it crosses. The bottom is first planked in the usual way, which being thoroughly caulked, she is double planked up to water line with white pine $3\frac{1}{2}$ inches thick, and fastened with composition bolts through every timber. There are eleven tiers of keelsons on the floor of the ship extending nearly to the ends. The ceiling and clamps are all square fastened, that is, two bolts in each plank through every timber, and the planks bolted vertically to each other edgewise between every frame. There are four water-tight bulkheads athwartship, and two fore and aft, making a box 105×18 feet, enclosing the engines and boilers. The longitudinal bulkheads are of double plank and timber, stiffened with cross-laid and riveted diagonal iron straps, similar to frames of ship, and add to her great longitudinal strength. The space between the latter bulkheads and sides of ship, are appropriated to coal, and the ports through which it is taken into fire-rooms are fitted with slide gates, which can be shut tight in case of accident causing the compartment to fill with water.

Engines.—Two inclined oscillating engines, one cylinder forward, the other aft, making with each other an angle of 90° , and connecting upon one crank pin, which connects the paddle wheel cranks, there being no "centre shaft" in the arrangement; by which is saved the centre-shaft, two centre-shaft cranks, one crank-pin, two engine frames, and two plumber-blocks. The channel plates do not, as in most other forms of marine engines, form any part of the foundation or frame work of the engine, and, together with the air pumps, feed pumps, bilge pumps, injection and bilge valves, are under the cranks, and all open to the view of the engineer, and accessible when the engines are in motion. The air-pump beams are of wrought iron worked by links connecting with crank-pin.

The engine frame, is a combination of cast and wrought iron, in the form of the letter **A**, being in section of one of the trunks between plumber-block and cylinder-trunnion, 18 inches wide by 3 feet deep. The sides



LITH. OF

Eng^d for the Journ^l of the Franklin Inst^e. Vol 31. Third Series.



OF LINDSAY & CO. N.Y.

Eng. for the Journ. of the Franklin Inst. Vol. 1, and 2.

NEW YORK AND HAVRE STEAM SHIP COS.
U. S. MAIL STEAMER FULTON.
2300 TONS.

and bottom of trunk are of plate iron $\frac{3}{4}$ -inch thick, riveted with $\frac{3}{4}$ -inch rivets in three and four rows. Cylinder trunnions are $24\frac{1}{2}$ inches diameter. The head of cylinder is fitted with a guide-yoke, extending beyond the stuffing box, and embracing the piston rod. This is a new and valuable arrangement, as it takes the pressure of the piston rod in oscillating the cylinder, and saves the stuffing box from any unusual wear.

The cylinder valves are of the usual balance poppet variety. The arrangement for operating them and effecting a cut-off, is new and ingenious. It is the invention of Mr. Hermann Winters, of the Morgan Iron Works. There are no rock shafts in the arrangement, but there is to each cylinder, three revolving shafts, by the motions of which, with their appendages, the lifting and lowering of the steam valves is accomplished by two distinct motions—the lowering being the quickest. The same shaft also gives to the exhaust valve, a greater average opening than is obtained by the common rock shafts. The point of cutting-off is variable and adjustable while the engine is in motion. A combination of this arrangement admits of the engine being reversed instantly, and worked back full power, with the eccentric “hooked on,” without shifting it; a feature of very great importance. The boilers are of the variety known among engineers as the “Martin boiler;” and for which, Daniel B. Martin, Esq., Engineer in Chief to the U. S. Navy, has a patent. The tubes are of brass, without seam; being drawn from brass ingots by the American Tube Co., Boston. The water passes through the tubes, and the fire around them, the same as in the vertical tubular boilers, which have for five years performed efficiently and economically, on the New York and Liverpool U. S. Mail Steam Ships, where they were first successfully introduced on ocean steamers, through the enterprise and liberality of E. K. Collins, Esq. In the Collins’s boilers, the tubes are located directly behind, and adjoining the furnace, and take the “direct action” of the flame. In the *Fulton*’s boilers, the tube-box is located *over* the furnace, and take the “return action” of the flame. The latter plan has been adopted for all the new Government Steam Frigates, and the new Collins’s Steamer *Adriatic*.

The engine department is provided with two of Worthington’s steam fire engines, and bilge pumps, of extra large size, the steam cylinders being 16 inches diameter, and made expressly for this ship. They are operated for port use, by a small auxiliary boiler, but at sea, are connected with the main boilers, and in case of fire or leakage, would perform very efficient service.

The engines are surrounded with three ornamental iron galleries, affording great convenience for inspecting every part of the engine. The whole was arranged by Mr. Myers Coryell, Constructing Engineer for the Morgan Iron Works, under the superintendence of the Company’s Resident Engineer. No attempt has been made to secure extraordinary speed, which costs so many sacrifices of power, fuel, and freight capacity. The best day’s run on the first voyage, was 288 miles, when the pressure of steam was 20 lbs. to the square inch, and consumption of coal, 77,300 lbs. Pirsson’s fresh water condensers are to be added on the third voyage, when more steam will be produced from an equal combustion of fuel.

For the Journal of the Franklin Institute.

Particulars of the Steamer Etna.

Hull built by Laird & Co., Greenock. Intended service, Havre to New York.

HULL.—

Length on deck,	.	.	.	304 feet.	8 inches.
Breadth of beam, (molded,)	.	.	.	37 "	"
Depth of hold,	.	.	.	20 "	2 "
" " to spar deck,	.	.	.	28 "	2 "

Tonnage, { hull, 1222. }
 { engine room, 1001. } 2223.

Masts—3.—Barque rigged.—

ENGINES.—Over-head beam.

Diameter of cylinder,	.	.	.	76 $\frac{3}{4}$ inches.
Length of stroke,	.	.	.	5 feet.
Cut-off at	$\frac{1}{3}$.	.	.	
Average revolutions,	.	.	27.	
Gearing, .	.	.	2 $\frac{1}{2}$ to 1.	

BOILERS.—Four—tubular.

Load on safety valve per square inch,	14 lbs.
Number of furnaces,	14.
Consumption of coal per day,	45 tons.

PROPELLER.—

Diameter of screw,	.	.	.	14 feet	6 inches.
Pitch of screw, .	.	.	.	23 "	

Remarks.—Frames, shape $\perp$ $5\frac{1}{2}$ ins. $\times$ $\frac{5}{8}$ in. and 15 ins. apart. Thickness of plates, $\frac{5}{8}$ to 1 inch. Number of bulkheads, 5. Diameter of rivets, $\frac{3}{4}$. Distance apart, $3\frac{1}{3}$; single riveted. Independent steam, fire, and bilge pumps, 2.
 C. H. H.

For the Journal of the Franklin Institute.

Memoir :—On a new method of applying the power of Steam, and of Condensing the same after it has been so applied; the former is designated The "Differential" system of Steam Power, and the latter, The Hot Water system of Condensation. By THOMAS PROSSER, Civ. Eng., New York.

There are two methods of applying steam as a motor, the *positive* and the *negative*; to which I purpose to add a third, and to call it the *differential* method.

In the first or "Positive" method, the steam drives the atmosphere before it, and then loses itself entirely in it, without leaving a particle of the heat by which it had been created, to be returned into the boiler; all is lost after it has left the cylinder, and this constitutes the high pressure non-condensing engine.

In the second or "Negative" method, the principal use of the steam is to negative or remove the pressure of the atmosphere; the pressure of the steam may be insufficient to overcome the friction of the engine,

and, therefore, the air-pump is the real motor and acts as a *tug*; this is the low-pressure air pump condensing engine.

Many persons appear to suppose, that the simple injection of cold water into the condenser, sets and keeps the engine in motion at a very small expense, and that the air pump refrigerator is not much of a tax upon the power of the steam; but good authority shows that it is an enormous one. Dr. Ernst Alban says,* that "out of 17 lbs. total pressure, only about 7 lbs. are made available for useful effect."

Nothing, indeed, is necessary, but the presence of a desiccator to make the air pump condenser a complete freezing machine. Dr. Haycraft has some observations † on this subject in connexion with surcharged steam, which are important, as showing how the cold is produced and reproduced in the air pump condenser.

By the "Negative" method of using steam, the feed water is taken in at a higher temperature, so as to save from 4 to 5 per cent. of the fuel necessary to convert it into steam; this is really a very small affair, only about enough to work the air pump itself, while the great refrigerator is causing vaporization, ‡ and consequently producing cold to an enormous extent. But let that pass, while I proceed to show some of the advantages of high pressure steam.

There is more heat in the same weight of steam at a high pressure, than there is at a lower one; nevertheless, its density is not increased in the same ratio as its tension. § For example, steam at 230° Fah. has an elasticity of 42·3374", and a total heat of 1152° F., while steam at 356° F. has an elasticity of 297·1013," and a total heat of 1190·52° F.; so that, while the total heat has increased 1·03343 times, the elasticity has increased 7·01747 times, but the density || has increased only 5·93184 times, clearly showing that, whatever saving there may be in heating the feed water by the condensation of the steam, it is far inferior to the gain by

* The High Pressure Steam Engine investigated by Dr. Ernst Alban, translated by William Pole, London, 1847. John Weale, p. 58.

† Repertory of Arts, (3 S.) vol. xii, p. 25, (1831,) and London Mec. Mag. vol. liii, p. 288 and 302, (1850,) wherein the Doctor very handsomely acknowledges some former errors, but makes a promise, which I am sorry to say, has not been entirely fulfilled. The engine was exhibited in 1851, but the results are not known to me.

‡ Vaporization in a vacuum takes place at 68° F. according to Ginelin, (Cavendish translation, vol. i, p. 271,) so that the water in the air pump condenser is boiling away and carrying off the heat just the same as that in the boiler, but not quite so usefully.

§ Ginelin, vol. i, p. 259, gives the temperature 163° C., elasticity 3·571 met., actual density 443·32, density corresponding to the elasticity 714·2, showing a difference of 270·88, which is a gain of 61 per cent., from which, however, must be deducted the amount of heat, which, according to the text, exists in high pressure steam more than in that of a low pressure, and that leaves a gain of 48½ per cent.

"The higher the temperature, the greater is the difference; hence the advantage of high pressure steam engines."—Despretz.

|| The authority for the temperature, pressure, and other physical properties of steam is M. V. Regnault in the 21st vol. (1847,) of the Mémoires de l'Académie Royale des Sciences de l'Institut de France, a translation of which may be found in the *Journal of the Franklin Institute*, Vols. xv, xvi and xvii, Third Series. There is also a very meagre one by the Cavendish Society, (1848,) concluding with the ninth memoir, (there are ten in the original,) and an error in the last column which gives the total "heat above 32° F." instead of above 0° F. The density of steam I have calculated on the supposition that 490·463° represents the number of degrees necessary to double the pressure of air from 32°, and that steam obeys the same law. If, therefore, p = pressure and t = temperature, we have

$$\text{the relative densities} = d = \frac{p}{t + 490 \cdot 463}.$$

the application of high pressure steam, for while the former is only from 4 to 5 per cent., that of the latter is

$$14\frac{1}{2} \text{ per cent.} = \frac{7.01747}{1.03343 \times 5.93184}.$$

I do not purpose to go further into this investigation now, as I have sufficient data for my present purpose.

The points now arrived at, are these, that there is a saving by using high pressure steam on account of its elasticity increasing faster than the sum of its density and total heat, and that when such steam has a pressure of about 297" of mercury, the gain amounts to 14½ per cent.; also, that the small saving effected by pumping the feed water into the boiler of an air pump condensing engine at a somewhat increased temperature, is fully counteracted by the power necessary to work the air pump.

If, therefore, in our calculations, we omit for the present, all considerations of the additional heat given to the feed water, and also, the loss caused by excessive condensation in the cylinder of the air pump condensing engine, we may readily obtain a general expression, which will represent the economic value of that method of applying steam at any pressure, and which, at the same time, is equally applicable to the "Positive" and to the "Differential" methods.

The Differential method consists simply in using steam under two different pressures, the one in the boiler and the other in the condenser.

In the case of steam at 356°, I would have the laboring power = 255" (= 297" — 42") and of course the exhaust steam at 230°, which will heat the feed water to 221°, so that 970° (= 1191 — 221) must be restored in the boiler to the feed water pumped into it from the condenser.

In the "Positive" method of using the same steam, the laboring power will be = 267" (= 297" — 30") because of the removal of the 42" of *lively* back steam pressure, and the substitution of 30" of *dead* atmosphere therefor.

Now, the decreased power caused by using the steam in the manner which I have proposed is from 1. to .955056 $\left(= \frac{255''}{267''} \right)$ but as it is also the cause of the increased temperature of the feed water from 60° to 221°, the advantage of which is as 1.17629 to 1.

$$\left(= \frac{1141}{970} = \frac{1191 - 50}{1191 - 221} \right)$$

The sum of these two values is 1.12342 (= .955056 × 1.17629) which shows an increased economy of 12½ per cent. by using the steam "Differentially" instead of Positively, and as the latter has an advantage over the "Negative" of 14½ per cent., the "Differential" method has, of course, the advantage of a gain of 28.602 per cent., which is the sum of the two values. But even this, 28⅔ per cent., is quite below the real saving in fuel, for in addition thereto, the boiler is always clean and free from scale, which is another source of economy in fuel, as well as a great saving of time and hard usage, which other boilers are subjected to in scaling, so that there can be little doubt, as to the saving in fuel alone being fully 30 per cent. in land engines, and more than 60 per cent. in sea-going steamers, for I have excellent authority for stating, that the saving by using fresh instead of sea water is 25 per cent.

But, to return to the question of a general expression, which shall represent the three methods of using steam, I suggest, that $\epsilon = \frac{p-p'}{(t-t')d}$

where p is the pressure of the steam from the boiler upon one side of the piston, p' the pressure of the exhaust steam on the other side thereof, t , the total heat in the steam p , above 0° C., t' the temperature of the feed water, and d , the relative densities of the steam p . Surely no test more severe than this, can be desired against the "Differential" method. I shall use the Centigrade scale of temperatures, as being more convenient than the Fahrenheit, and in all respects conform as nearly as is practically desirable to the authority I have referred to.

The relative density of steam, therefore, will be represented by

$d = \frac{p}{t+272.479}$, which is of the same value as the equation given in

Note ||, p. 344 the change in the constant number being necessary on account of the adoption of the Centigrade, instead of the Fahr. scale of temperatures. The economic value of the fuel will then be represented as

before stated by $\epsilon = \frac{p-p'}{(t-t')d}$, but for greater perspicuity, I shall insert the whole of the numerals in the equation, and adopting the "Negative" method of using steam as the initial of value, working with steam of 1.415 atmospheres pressure, and 110° C. of temperature, with a total heat of 640° C., the condenser being at .155 atmospheres pressure, and the feed water at 10° C., * of temperature, we have,

lbs. per square inch of pressure above the atmosphere.		
Degrees C., of the working steam.		
6	110	Equation No. 1. "Negative." $1. = \epsilon = \frac{1.415 - .155}{(640 - 10), 1.415}$ $\frac{110 + 272.479}{110 + 272.479}$
75	160	Equation No. 2. "Positive." † $1.03715 \epsilon = \frac{6.120 - 1.}{(655.3 - 10), 6.120}$ $\frac{160 + 272.479}{160 + 272.479}$
55	150	Equation No. 3. "Differential." $.99929 \epsilon = \frac{4.712 - 1.415}{(652.2 - 105), 4.712}$ $\frac{150 + 272.479}{150 + 272.479}$

* The feed water, as before stated, is taken at the natural temperature, the same as in the "Positive" method, for the reason that at whatever higher temperature it may be, the advantage is absorbed in working the air pump.

† I have taken the nearest decade of temperature in the Table at the end of the ninth "Memoire," to avoid unnecessary trouble in the calculations. The slight variations in the results are of no importance whatever.

These coefficients of ϵ , all represent about equal values, and the table gives the necessary pressures above the atmosphere for the steam to be used in each case, to work with equal economy of fuel, at 6 lbs. for the "Negative," 75 lbs. for the "Positive," and 55 lbs. for the "Differential" methods; a result which few probably would have anticipated under the circumstances, for, not a single advantage is given to the "Differential" method, while every disadvantage has been omitted that might tell against the "Negative," as well as against the "Positive" ones.

If we allow about 15 per cent. of waste by condensation in the cylinder of the air pump condensing engine, making the initial of economic value = 85ϵ , we shall find, that, to work with equal economy of fuel, both the "Positive" and the "Differential" methods will require the steam to be 38 lbs., when on the "Negative" method it is 6 lbs. above the atmosphere.

I will now show the economic value of each method under a pressure of 131 lbs. to the square inch, above the atmosphere.

lbs. per square inch of pressure above the atmosphere.		
Degrees C., of the working steam.		
131	180	Equation No. 4. "Negative." $1.26484 \epsilon = \frac{9.929 - .155}{(661.4 - 10), 9.929}$ $\frac{180 + 272.479}{180 + 272.479}$
	180	Equation No. 5. "Positive." $1.1559 \epsilon = \frac{9.929 - 1.}{(661.4 - 10), 9.929}$ $\frac{180 + 272.479}{180 + 272.479}$
	180	Equation No. 6. "Differential." $1.2899 \epsilon = \frac{9.929 - 1.415}{(661.4 - 105), 9.929}$ $\frac{180 + 272.479}{180 + 272.479}$

It thus appears, that, if the "Negative" method is practicable, there will be a gain of $26\frac{1}{2}$ per cent. in using steam at 180°C. , instead of 110° .

In like manner the "Positive" method shows an advantage of $15\frac{1}{2}$ per cent., but in both cases the gain results from the increased pressure.

In the "Differential" method, on the contrary, the gain of 29 per cent. results from the increased temperature, both of the working steam, and of the feed water, the latter being the chief feature of the system; the gain by the former is $15\frac{1}{2}$ and by the latter about $13\frac{1}{2}$ per cent.

High-pressure steam with the "Negative" method is out of the question, for the innate disadvantages become too glaring; the enormous proportions of the air pump and condenser must be increased, and the condensation in the cylinder will be increased in a still higher ratio, on account of the increased difference in temperature between the exhaust and the working steam.

No one will, I trust, deny that thus far I have shown the "Differential" system to be far superior at every point to the "Positive" method, and fully equal at moderate pressure even to the "Negative" one, while it is more than equal to it at high pressures, if, indeed, that be practicable at all on the "Negative" system. And now, what shall we allow for the loss of power by condensation in the cylinder of the air pump condenser, and other causes? And, what shall we allow of useful effect on the "Differential" plan? Dr. Ernst Alban (p. 85,) says, that the former returns but 41.2 per cent. of useful effect, while the ordinary high pressure engine returns 75 per cent.; others make the difference still greater; but I am content to take 50 per cent. of useful effect as resulting from the "Negative" method, and $73\frac{1}{2}$ per cent. for the "Positive" one. The proportions of useful effects are, therefore,

as 1 to $1.465 \left(= \frac{73.25}{50} \right)$ showing a gain of $46\frac{1}{2}$ per cent. as due to the

economy of high pressure steam, superadded to the loss by condensation in the cylinder of the low pressure air pump condensing engines. To this we must add the gain of $13\frac{1}{2}$ per cent., which results from the "Differential" method of using the steam, and which is an entirely distinct source of gain, and consists in feeding the water into the boiler at a higher temperature. Therefore, $1.60 (= 1.465 + 13\frac{1}{2})$ represents the economic value of the "Differential" method, when 1 represents that of the "Negative" one. In other words, the useful effect of the fuel is 60 per cent. in favor of the "Differential" method of using the steam, even in the ordinary land engine. For sea-going steamers, the saving of fuel is 25 per cent. more, making a gain of 100 per cent. If, then, these calculations are correct (and their simplicity almost forbids the possibility of error), there can be no manner of doubt that the Atlantic may be crossed by steamers adopting the "Differential" system, with less than half the fuel now usually consumed. A transatlantic steamer of the largest class, will consume 1600 tons of coal per voyage out and home, on the average of the year round. This coal really costs, to get it on board, and to get it off again, together with the useful space occupied by it and the boiler, and the whole apparatus for its consumption, not less than \$20* per ton, or \$32,000 per double voyage. The half of this expenditure I propose to save, simply by consuming but half the quantity of fuel to produce the same effect; and on the half so consumed, I propose to save half the space occupied by the boiler, and also half the cost thereof (as they will last double the time), making \$2.50 per ton on 800 tons, or \$2000 more to be added to the half of \$32,000, showing thereby, a saving of \$18,000 on every voyage hence to Liverpool and back.

As much depends upon showing that there is a great loss by the use of the air pump, which causes condensation in the cylinder, I may be

* Cost of one ton of coal, with labor to put on board, to consume it when on board, and then throw the ashes overboard, .	\$ 7
Value of space occupied, ...	8
Space occupied by boiler to consume coal, ...	2
Cost of so much boiler, ...	3
	\$ 20

permitted to return to that point again. Not that the "Differential" system is less the *true one* even without that proof, but, because that alone is necessary to put the matter beyond dispute or conjecture. If any power can be gained by the use of the air pump, nay, if it is not the cause of an absolute loss of power, it is quite different to all other mechanical action, which is ever reduced in power by a transfer to a secondary object, just as the steam engine may and has been used to pump up the water to operate a water-wheel, but, of course, with the loss of power due to the friction of both combined. When the steam has forced the piston to the end of the stroke, and is suddenly condensed, the same operation is going on upon the metallic surfaces open to the condenser, to wit, the cylinder and the piston on one side or the other, so that when the steam is again let in, these cooled surfaces must necessarily condense a large portion of it, by many estimated at fully one-half. By working expansively, however, as soon as the steam is cut off, the reduced pressure causes the water in the cylinder to re-boil, and the surplus heat contained in the steam when of higher pressure takes it up, and hence the indicator gives no record of the fact. If the commonly received notion is correct, we get a mechanical something for nothing, and are in the neighborhood of perpetual motion.

Dr. Ure employed the vacuum formed by the condensation of steam in a separate vessel, to produce attenuation and consequently refrigeration of the air under a receiver, and thus dispensed with all mechanical power to pump out the air; but, it never entered his head that it cost nothing to do it, nothing in fuel. The waste by air pump condensation is pretty well ascertained by the gain in using surcharged steam, for that gain can be but the absence of a portion of the waste referred to, just as a very bad boiler may be proved to be a paragon of perfection when compared with another infinitely worse.

The anomaly of reducing the temperature of the water resulting from the condensation of the steam, for the purpose of having to heat it again, under the impression that the removal of the pressure of the atmosphere can by any possibility be an equivalent therefor, is quite contrary to all analogy and sound argument. Need I adduce any other proof against the value of the "Negative" method, than the fact, that, no one thinks of using high pressure steam in such a manner, when there can be no objection to doing so if the principle is right? The already enormous proportions of the air pump and condenser must be vastly increased, the condensation in the cylinder will be increased also, in proportion to the increased difference of temperature between the working and the exhaust steam.

By the "Differential" method, the cylinder is instantly exposed to a temperature of 105°C . when opened to the condenser, being a difference of 75°C . ($180-105$), while the air pump condenser is usually about 46°C ., showing a difference of 64°C . ($110-46$), although the pressure of the steam is but *one-seventh*. In Hall's surface condenser, the difference was not less than 94°C . ($110-16$), and so of other surface condensers to be equally as good as his was; however, the condensation in the cylinder is considerably increased thereby.

Nor must we pass by the amount of condensing water used, which in

the surface condenser of Hall, amounted to 300 lbs., to condense 5lbs. of steam per minute with 58 feet of metallic surface;* *i. e.*, 60 lbs. of condensing water to one by weight of steam condensed, which is nearly double the amount used by Watt,† and *twelve times* as much as is required on the "Differential" plan.

That the condensation in the cylinder is very great, no one has ever denied—of its amount, however, I have only represented the opinions of others, and do not rely on them, but shall content myself‡ in ascribing it to no other cause than the simple difference of temperature between the working and the exhaust steam. We shall thus get rid of all the *mystery* which attaches to the case. From my own experience of the working of the "Differential" system, I am satisfied that the amount of condensation in the cylinder does not exceed two per cent., if indeed, it is as much. This will give 12 per cent. for condensation in the cylinder of an injection air pump condenser, and nearly 18 per cent. for Hall's air pump surface condenser, which is most decidedly the best of its class. The "Differential" method has in the above calculation, seven times the pressure of steam, and $\frac{7}{8}$ the difference of temperature of the injection "Negative" method, and hence, the latter must condense about 6 times as much as the former, while the air pump surface condenser must condense nearly 9 times as much. It is well known that Hall's condenser did not economize fuel to the extent that was calculated upon; and I would ask, may not this statement account for it? Adhering to my modification of Dr. Ernst Alban's statement, that 50 per cent. can be obtained of effective power from the condensing air pump engine, while $73\frac{1}{4}$ per cent. is obtainable from the non-condensing one, we have a loss of power,

By the different methods of	"Negative."		"Differential."
	by Injection.	by Surface.	
Condensation in the cylinder,	12	18	2
Friction and all other causes,	38	38	$24\frac{1}{2}$
Loss per cent.,	50	56	$26\frac{1}{2}$
Effective working power,	50	44	$73\frac{1}{4}$
	100.	100.	100.

That the "friction and all other causes" on the "Negative" plan, will be much more than I have allowed, as compared with the "Differential" one, I believe will be readily granted, when it is considered that the dia-

* Tredgold on the Steam Engine (1838), p. 371.

† Farey on the Steam Engine, p. 593.

‡ I do not mean by this to disparage any of the authorities whom I have quoted, but only to avoid the possibility of error in my calculations, by taking nothing for granted which is not thoroughly recognised; and, therefore, I apply to this case the rule laid down and universally admitted, that, the rate of cooling is directly as the difference of temperature. This rule, however, only applies to dry gaseous bodies; where moisture is present in the cooling medium, the effect is greatly increased, and this in fact is the case under consideration, but for the reasons stated, I abandon this source of advantage to the "Differential" method, in these calculations, to avoid abstruseness, as I can well afford to do, where the gain is so great without it.

meter of the piston and the stroke also must be doubled to obtain the same power. I think this method of accounting for a well known fact, is much better than introducing any imaginary ones, however ingenuous, into the argument, as some have done in regard to surcharging, and other methods of using steam, which can effect nothing more than the prevention of condensation in the cylinder. But the views which I have suggested, do not in the least detract from the advantages claimed for the "Differential" system, but I do not wish to undertake the defence of anything except the "Differential" system.

In my method of condensation, I use three annular surface condensers, each in its own cistern. The bottom one distils the water to make up for waste. The cistern first receives the *cold condensing water*, which becomes somewhat warmed therein, and then enters the *main condenser cistern*, where it is made to boil before leaving it as *waste*; but a portion of it, forming vapor, goes over and down into the *distilling condenser*, and thus becomes condensed and is collected, as is also that from the *main condenser*, by means of a pipe from the bottom of each, passing through the bottoms of their respective cisterns to pumps, which force the water through the sides of the *cistern* above into the *heater condenser*, and from thence into the boiler, having become heated by the exhaust steam, which first enters at the bottom of this upper or *heater condenser cistern*, and after having performed its office of heating the feed water, goes into the *main condenser*, and the water resulting from its condensation is collected as before stated. The *bottom condenser* then, (to recapitulate,) receives the vapor from the *main cistern* to make up for waste and other purposes, the *main condenser* receives the exhaust steam and the *heater condenser* the water from both, while the cistern of the *heater condenser* receives steam only, and the other two cisterns condensing water only.

The *main condenser* has a pipe from near the bottom, which, when open, allows the engine to work without condensation, or, it may work with condensation, and yet no steam escape if the supply of condensing water is sufficient. In case, however, it is required that the *still condenser* shall be brought into full operation to make up for extraordinary waste, this pipe must be closed, and then the water in the *main cistern* commences to boil rapidly, and the vapor therefrom goes over into the *distilling condenser* as before stated.

In concluding this part of my subject, leaving for another opportunity the means by which I purpose to render steam of any pressure far safer than the ordinary steam which is now used, in addition to that of a certain supply of water which the "Differential" system insures, and which shows so markedly its immense advantage over all others in that, the point of greatest importance to a boiler, inasmuch as it is not only self-feeding with regard to the steam condensed, but it has also a source of supply always in action, to make up for waste, which no other condenser has (except by a separate apparatus); I will observe, that the "Differential" system does not require the amount of back pressure which I have assigned to it, unless boiling hot water or steam is required in abundance for culinary or other purposes. Where, however, this is the case, and the whole

heat can be usefully applied for drying-stoves or such purposes, more than half the fuel used under the boiler may be economized through the medium of the hot water or steam, or both, being passed through attenuators or other apparatus for that purpose.

I will, therefore, now show the comparative economic value of the "Differential" system, when working in ordinary, and only producing as much distilled water as will make up for the waste of the engine and its boiler, premising, that none of the steam which condenses in the cylinder or exhaust pipes is allowed to enter the condenser, but goes to waste.

lbs. per square inch of pressure above the atmosphere.		
Degrees C. of the working steam.		
131	180	Equation No. 7. "Differential."
		$1.34593 \epsilon = \frac{9.929 - 1.045}{(661.4 - 105), 9.929}$
		$180 + 272.479$

Here, then, we have a gain amounting to $34\frac{1}{2}$ per cent., of which $15\frac{1}{2}$ (see Equation No. 5) is due to the high pressure, and 19 to the "Differential" system of applying the steam.

For the Western waters, where people are not easily frightened by a name, I would recommend steam of not less than 200 lbs. to the square inch (and the same for locomotives, but not for ordinary boilers be it remembered), and then the following equation may serve :

lbs. per square inch of pressure above the atmosphere.		
Degrees C. of the working steam.		
211	200	Equation No. 8. "Differential."
		$1.42354 \epsilon = \frac{15.380 - 1.181}{(667.5 - 102), 15.380}$
		$200 + 272.479$

In this example, the working steam is supposed to be at 200°C ., and the condenser at 105°C ., while the feed water is at 102°C ., and the main condenser cistern or "hot well" at 100°C .

It is useless to inquire further into the workings of the "Positive" system, because its great inferiority, except at about 38 lbs. above the atmosphere, has been fully shown before. It is true, however, that this system does admit of a higher temperature being given to the feed-water through the medium of the exhaust steam, than it is possible to attain on the "Negative" system. Heaters may be applied to abstract a few

degrees of heat from the exhaust steam and give it to the cold feed-water, but the condensed steam is necessarily lost, and with it the great object in view, *pure water under all circumstances.*

The "Differential" system, on the contrary, has no cold water to warm, for the feed water, excepting that portion of it which is to make up for the waste (and even that is warmed before entering the heater,) is not allowed to become cold at all, but is taken from the main condenser as soon as it has assumed the form of water, and pumped into the heater condenser at very nearly the boiling point, so that the demand upon that portion of the apparatus is comparatively small. The view which I have taken of the "Positive" method, may appear to be somewhat at variance with the popular one, which assigns to it a superior economy when working with steam at a high pressure, over the "Negative" method, but, this arises from my having allowed the same pressure to be applicable to both. If, however, high pressure steam cannot be economically applied on the "Negative" system, the popular point of view is doubtless the correct one. I have not before alluded to the advantages of using the steam expansively, because, that method of working is equally advantageous to all of the three systems. Nor do I think it necessary to do more than allude to the possibility of expanding high pressure steam until it shall become powerless for all useful effect, for there is a point at which expansion must cease, and that, too, long before it is too feeble to get out of the way of its successor, or has to call upon a vacuum to help it along. I speak of good honest steam, which does its own labor, and then "clears out," without waiting to be dragged out or to be kicked out.

Equations Nos. 7 and 8, speak for themselves: allow that there is a loss by the "Negative" method of 12 per cent. by condensation in the cylinder with injection, and 18 per cent. with surface condensation, and the former equation shows a gain of 53 per cent. on the one, and 64 per cent. on the other, to which in the case of sea steamers we may add 25 per cent. over all, and then we show a gain of 91 per cent. in one case, and in the other 105 per cent. on unquestionable data, without resorting to the undeniable advantage on account of the greatly reduced size of the engine.

In Equation No. 8, for even pure water, such as the Lakes have, the gain shown is 60 per cent. over the "Negative" method, with the like allowance for condensation in the cylinder of the latter, but on the "Differential" plan, at this pressure, there is none whatever. For the muddy water of the Mississippi, the gain must be fully 100 per cent.

In conclusion, I will remark, that the "Negative" system with injection, is not economical, on account of its secondary action, and large surface exposed to a great difference of temperature between the two sides of the piston, nor does it admit of the use of its condensed steam, nor the application of heaters to any useful extent. The surface condenser when applied to the same system is still less economical on account of the same defect of secondary action, and still greater difference of temperature to which the cylinder is exposed as well as to the same large surface, and although it does admit of the re-use of its condensed steam, (and filth from the cylinder,) it is greatly reduced in temperature, which has to

be restored in the boiler, but it neither provides for waste supply, nor are heaters of any use.

The "Positive" system is no better than the foregoing. True, it admits of heaters to warm the cold feed water somewhat, but throws away the very source from which it derives that warmth; a source too, of entire purity as well as of great heat, while the medium to which it is transferred is quite cold, and more or less impure, and, so far, unfit for the purpose to which it is applied.

Moreover, the complication of the machinery of the "Negative" method, together with the large space which it occupies, are most serious objections of themselves, particularly on a steamboat; and the objections to the "Negative" and the "Positive" methods, point only to such defects as show the subterfuge nature of both and the great mistake of the air pump, which, however valuable in its day, has outlived its need. Such a condenser as the "Differential" system requires, could not have been made when the air pump was first introduced, and even now, the chief difficulty encountered has been in the practical details. Per contra, the "Differential" system has no secondary action to absorb its power, nor has it any large surface or *space* to absorb its heat. It admits of the re-use of its condensed steam and throws away the filthy part, to use none but the pure, and makes prodigal provision for a supply, not only to make up for the waste occasioned thereby, but also for any other, and on board a steamer for the use of all on board, for any purpose whatever, and with any quantity to spare and at no cost. It provides, also, against lowering the temperature of the condensed steam much below the point at which it assumes the shape of water, for re-heating, even of that much and more, through the medium of heaters, before it again enters the boiler. Therefore, it retains its source of heat intact, after it has left the cylinder, and it retains its purity too, while the impure sloughs away in a soapy state, which would otherwise clog the action of the valves, and line both condenser and boiler with a coat of non-conducting grease. The waste supply is pure also, from whatever source, (however impure,) it is obtained. The machinery is of the simplest possible character, and occupies the smallest possible space, having in that respect every advantage of the "Positive" system, (with many others,) and none of its disadvantages, nor has it any other. In its refuse waste water, it has an advantage too important to be omitted, for, being at a full boiling heat it is available for cooking purposes, as well as for warming the air of houses, manufactories, or ships, for which purposes the waste water on the "Negative" system of working is quite useless, and the exhaust steam from the "Positive" one, very objectionable.

If the "Differential" system is not the true and *catholic* one, on which to operate the steam engine for every purpose, whether upon the land or upon the water, in the mine or on the rail, where water is plentiful, and where it is scarce; I must confess to great obliquity of mental vision, and hope soon to be enlightened, not on that subject only, but also on the amount of condensation which takes place in the cylinder, and the loss of power occasioned thereby: I confess my own inability to ascertain either, mainly, as I believe, because the condensation is many times more in a wet cylinder than it is in a dry one, and its hygrometric state is con-

tinually varying. Moreover, I believe, that low pressure steam generally causes the cylinder to be wet, while high pressure steam, at least when used expansively, causes it to be dry. That expanded steam is dry, I endeavored to prove some years ago,* and although it was a mere deduction, and as it appeared to me a necessary one from the experiments of others, it has since been proclaimed as an *original* observation of somebody else on the other side of the Atlantic.

If I have thus far rested the claims of the "Differential" system upon calculations, they are such as challenge the strictest scrutiny, being founded upon facts not liable to error, whether supported by experiments or not. Still, I have not depended upon mere calculations, but, have been engaged for years in embodying them, and at great sacrifice of money and of time, have succeeded in doing so.

My experiments have discovered to me the fact, that, with steam of about 50 lbs. above the atmosphere, cut off at two-thirds of the length of the stroke, (stroke 18 inches, piston 8 inches diameter,) making 50 strokes per minute for 10 hours per day, the condensation in the cylinder does not amount to two per cent. of the whole steam which passes through it, at least that is all which I could collect from the exhaust pipe before the steam went *up* into the condenser. With higher pressure steam and cutting off sooner, I believe there is no condensation at all in the cylinder after it has become warmed by working some time. I am well acquainted with the value deservedly attached to experiments intended to prove a foregone conclusion, arrived at in perfect good faith it may be, before the invention is put into operation, and then it is wonderful to see the performance "exceed the most sanguine expectations of the inventor." And thus, the supposed fact, instead of causing him to pause as being certainly wrong in his conclusions or in his premises, is extolled as proving the truth instead of the error of his deductions. It is like a "spiritual manifestation," which none but the victims may see. I cannot do better with reference to this sort of delusion, than by telling what happened to a very clever man in England, about 100 years ago.

Mr. Keane Fitzgerald† introduced air into the boiler of a steam engine, by means of a pipe coiled around on the inside of the bottom of it; the pipe was pierced full of holes, and the air was forced into it by means of a pair of bellows worked by the steam engine itself, and was to rise through the water in *bubbles*, and assist the formation of steam, and on trial was proved to effect a saving of *one-sixth* of the fuel, for it raised one-sixth more steam with the same fuel. The next year, however, like an honest man as he was, he stated that he was entirely deceived, for that "the bellows had never forced any air at all into the boiler, having been split withinside."

What if I should close now? It may be said that I have not shown the universal applicability of the "Differential" system, by omitting a formula for locomotives. I therefore subjoin one, showing the ordinary or "Positive" way of working, and allowing (not my allowances, but that

* July, 1847, *Journal of the Franklin Institute*, (Third Series,) Vol. xviii, pp. 134 and 229.

† 1757, *Philo. Trans.* (Vol. I, p. 53,) also, *Farey on the Steam Engine*, Note, p. 245.

of Messrs. Stephenson,) 6 lbs. above the atmosphere for the back pressure occasioned by the use of the blast.

lbs. per square inch of pressure above the atmosphere.		
Degrees C., of the working steam.		
131	180	Equation No. 9. "Positive." $1 = \varepsilon' = \frac{9.929 - 1.415}{(661.4 - 10), 9.929}$ $180 + 272.479$
211	200	Equation No. 10. "Differential." $1.25257 \varepsilon' = \frac{15.380 - 1.962}{(667.5 - 115), 15.380}$ $200 + 272.479$

The "Differential" method, shows a gain of $25\frac{1}{4}$ per cent. over the "Positive" one, partly owing to the use of steam of greater pressure; but that forms a part of the system, as will be shown hereafter; for the boiler which renders this pressure far more safe than a much lower pressure is in any other boiler whatever, is not applicable to any other system than the Differential one, although the condenser is applicable to any boiler; the "Differential" method is, therefore, entitled to the credit of the whole gain of $25\frac{1}{4}$ per cent. There will, however, be required an additional water-tender to work on the the "Differential" system for the purpose of condensation, and that is all the additional weight required, as the boiler, condenser, and engines with fuel and water in working order, will be less than on the present plan, and there are two considerations, either of which far outweighs the cost and charge of this addition; the one is the certainty of always having *pure water*, and the other, a *noiseless blast*, for a broken winded horse of flesh and bone is not, physiologically speaking, one whit more defective than a grunting, snorting iron one.

The quantity of water required for condensation is calculated at three times as much as the feed water, of which one-sixth or half as much as the feed water, is to escape in the shape of steam to the chimney, to answer the purpose of the blast, rather more economically I apprehend, than by forcing it out by the power of the engine.*

* The Messrs. Stephenson, admit that the obstruction caused by the blast, is 6 lbs. per square inch on the average, and sometimes "the whole loss of power" they say, "amounts to nearly half that of the engine," and yet, singularly enough, they state further on, that, no power is wasted upon working any machinery for the purpose, and it has the advantage of great simplicity in its application." Of course, the power is not wasted, if the labor must be performed, as they assert that it must be by the engine, but, may not the blast be taken direct from the boiler? The condenser on the "Differential" system is, to all intents and purposes, a boiler, and the blast may be taken from that at no cost whatever, for the back pressure is compensated for by the increased temperature of the feed water. The words last quoted, therefore, do apply most forcibly to the "Differential" system, but not to the "Negative" one.

The back pressure which I have allowed on the "Differential" system, (Equation No. 10,) is 14 lbs. to the square inch, and if that be not sufficient, any amount that can be required to give greater heat to the upper part of the condenser is easily attainable so as to generate the requisite force of steam for the blast. This point is of considerable importance, and forcibly illustrates the flexibility of the system, the universality of its application having, it is hoped, been established before.

And thus, I launch my *barque* on the ocean of public opinion, asking for it only the favor of an impartial consideration.

For the Journal of the Franklin Institute.

On the Evaporative Efficiency of Martin's Vertical Tubular Boilers.

By J. VAUGHAN MERRICK.

The machinery of the United States Steamship *Susquehanna*, has recently been thoroughly refitted and furnished with four new boilers of the above description, by Merrick & Sons, Philadelphia. The boilers are of iron with brass tubes and have the following general dimensions :

Length of each boiler, (athwartships,) . . .	11 feet.
Breadth " " (fore and aft,) . . .	15 "
Length of vessel occupied by four boilers, . . .	31 " 8 inches.
Breadth " " and fire-room, . . .	31 "

The fire-room is between the two pairs of boilers, the furnaces firing athwartships, and the flues delivering into one chimney, each boiler having one-fourth of a steam drum.

Height of boilers exclusive of steam drum, . . .	13 " 6 inches.
" " inclusive " " . . .	15 " 10 "

Cubical space occupied by all the boilers and fire-room, being the content of a parallelopipedon included within the above circumscribing lines, throwing off the steam drum, which is between decks, . . .

13240 cubic feet.

Number of furnaces in all boilers, . . . 20.	
Breadth " " each . . .	2 feet 5 inches.
Length " " " " . . .	7 "

Grate surface area in all, . . . 338 sq. ft.

Number of tubes in all boilers, . . . 5480.	
Length (or height) " " . . .	36 inches.
Diameter (outside) of the tubes, . . .	2 "

Heating surface in furnaces and back connexions up to tubes, 1614 sq. feet.

" " tubes, . . . 8508 "

" " tube boxes and connexions to smoke chimney, . . . 1581 "

Total heating surface in all boilers, . . .

11,703 "

Proportion of the same to grate area, . . .

34.6 to 1.00

Flue area or calorimeter between tubes in all boilers, . . .

42 square feet.

Proportion of the same to grate area, . . .

1 to 8 " "

Diameter of smoke chimney, . . .

8 feet.

" ventilating chimney within and concentric with it, . . .

2 "

Area of annular space or chimney, . . .

47.12

Proportion of the same to grate area, . . .

1 to 7.4

The boilers have water bottoms, with not less than 6 inches of water space at any point ; back of the furnaces these bottoms rise to the back connexions : the tube boxes are above the furnaces, and rise slightly to the front end of the boiler, where they enter the front connexions. The

boilers are of $\frac{3}{8}$ - and $\frac{1}{2}$ -inch best American plates, double riveted and caulked inside and out, throughout, and are well braced. The weight of all four, when empty, is 255,000 pounds. Their total weight when filled to the working level, is 440,000 pounds.

To test the economical evaporative efficiency of this form of boiler, an experiment was made on the 13th of March last, in the presence of several engineers of the Navy, the conditions and results of which were as follows:

Two boilers only, were used, and the dampers were nearly closed.

The coal used was Anthracite, and of an inferior quality. The engines are fitted with Stevens' cut-off, which was adjusted and permanently fixed to cut off as follows:

Port engine, one end	3.88	Starboard engine, one end	4.60
"	4.12	"	3.35
Average per indicator card, with full throttle,			3.97 feet
Adding to this the average clearance at each end of the cylinder, and including, also, the steam passage, &c., between valves and cylinder, equal to 23,820 cubic inches, or the area of the cylinder by 6.05 * inches of stroke, or			
			504 feet.
Average length of cylinder, filled at each single stroke,			4.474 "

Preserving the same level of water in the boilers, and (as nearly as could be ascertained) the same quantity of coal in the furnace, or about the same fires, and maintaining the same pressure of steam, 4200 pounds of coal were consumed, and 1615 revolutions, made and noted by register, the duration of the experiment being 3 hours 57 minutes. During this time, eleven double cards were taken on the two engines, which showed a mean pressure of steam entering the cylinders during that part of the stroke over which steam was admitted of

18.99 pounds, Port engine, Total pressure.

21.81 " Starboard " " "

of which (Pambour) the volume is 1257.

Hence, the water evaporated during the experiment was as follows: the two cylinders being 70 inches diameter = 26.71 square feet area.

$$\frac{26.71 \times 4.474 \times 1615 \times 4}{1257} \times 62.5 = 38,372 \text{ pounds water,}$$

which being evaporated by 4200 pounds coal, gave 9.137 pounds of water per pound of fuel.

The temperature of the hot-well, was $89\frac{1}{2}^{\circ}$, and of the feed-water entering the boiler at (probably) 85° .

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, April 17th, 1856.

John Agnew, Vice President, in the chair.

John F. Frazer, Treasurer.

Isaac B. Garrigues, Recording Secretary.

* This enormous amount is taken from actual measurement, and is in a great measure incident to the form of engines (inclined) with which the ship is supplied.

The minutes of the last meeting were read and approved.

Letters were read from Th. Lawson, Surgeon General, United States Army, and from the American Institute of the City of New York.

Donations were received from the Commissioners of Patents; and the Statistical Society, London; M. Hector Bossange, Paris, France; The Regents of the University of the State of New York, and William J. M'Alpine, Esq., Albany, New York; Hon. Job R. Tyson, United States Congress, and Th. Lawson, Surgeon General, U. S. A., Washington, D. C.; Prof. William Chauvenet, Annapolis, Md.; The American Institute, City of New York; The Young Men's Library Association, Cincinnati, Ohio; and from Messrs. W. Jones, Dr. H. Hartshorne, Dr. L. Turnbull, and Frederick Graff, Philadelphia.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer read his statement of the receipts and payments for the month of February.

The Board of Managers and Standing Committees reported their minutes.

Candidates for membership in the Institute (3) were proposed, and the candidates proposed at the last meeting (5) were duly elected.

Mr. Washington Jones exhibited a cushion life-preserver, invented by Mr. George Fried, Jr., of this city. The cushion is of the usual form adapted for chairs, benches, settees, sofas, and other similar articles of furniture used on steamboats and other vessels.

The cushions are stuffed partially with cork shavings, and partially with hair or other soft substance, the cork being packed into the lower portion of the cushion, and being divided by a piece of muslin, or other suitable fabric, from the softer material in the upper portion. The exterior of these cushions may be made of oil cloth, leather, india-rubber, cloth, or other suitable material, to which suitable bands or straps are fastened, for securing the whole to the breast when used as a life preserver.

Mr. Fried has furnished the boats of the West Jersey Ferry Co. with his cushion life-preservers, and has taken the necessary steps for procuring letters patent.

Mr. H. Howson exhibited a model of an improved axle-box for locomotives and cars, for which a patent was granted to Mr. D. R. Perkinpine, of this city, in March last. The novelty of this invention consists in the front and bottom of the box being readily removed in one piece, allowing the journals to be easily examined and cleansed, and the oil reservoir to be removed and replaced with facility.

Mr. Howson, also, exhibited a very ingenious apparatus for removing the cut grain or grass from harvesters, invented by Samuel Comfort, Jr., and patented in March last. It consists in the employment behind the cutter bars of harvesters, of a grated platform, and a radial grating. To the former a vertical reciprocating motion is imparted, and to the latter a radial as well as tilting motion; these motions being produced by means of inclined planes, levers, rods, and cranks, operated from any moving part of the machine. The radial grating and grated platform are so arranged and operated, that the grain or grass falling on the latter, may by means of its vertical reciprocating motion, be deposited on the former,

which, by its radial movement, conveys it to one side of the machine, and by its tilting movement turns it over on to the ground. The whole is designed for the purpose of avoiding the friction produced by the use of automatic rakes, usually employed for effecting the same purpose.

Mr. Howson, also, exhibited a drawing of the boiler of the late steam ferry boat "*New Jersey*." Mr. H. remarked, that the drawing was made from a sketch furnished by Mr. Allen, the Superintending Engineer of the Ferry Company; that he had examined the boiler minutely, and found the fire-box in a most dilapidated condition, with such a mass of bulges, and patches, that it was perfectly miraculous how it stood the pressure required. At the back, the fire-box communicated with two flues, and these, with four upper circular return flues leading to the chimney. Between the two lower flues, was a water space, or leg, in which two leaks were discovered. Mr. Howson, observes, that the situation of this leg was such, that no circulation of water could there take place, and that, consequently, sediment was likely to collect there to a dangerous extent; that the heat from the furnace, together with corrosion, had caused the leaks. The water escaping through these leaks, was instantly converted into steam, which filling the flues, forced the flame from the fire either through the doors, or through the grate bars, upwards in front of the boiler, and instantly ignited the wood work above.

Prof. Frazer concurred in Mr. Howson's remarks as to the origin of the fire on the steamboat *New Jersey*; and said that the flame in front of the boiler, would, under such circumstances, be of a blue color, as described by the witnesses at the Coroner's inquest.

The Vice President, Mr. Agnew, who, by the desire of the Coroner, had examined the boiler in conjunction with Mr. Howson and Mr. J. L. Kite, exhibited a piece of iron, which he had broken from the edge of the leak, and also agreed with Mr. Howson, as to the origin of the fire.

Mr. F. De B. Richards presented for examination two cork models—one of the Temple of Neptune at Pæstum, the other the Sybil Temple of Tivoli. Pæstum, the ancient name of which was Posidonia, is of early origin, and but little is known of its history; it was a Greek city, which is proven by the existing monuments, most conspicuous of which of the Neptune Temple, it is in fine state of preservation, having been built in a calcareous stone from the adjacent mountain; the dimensions are as follows: length 195 feet, 4 inches, breadth 78 feet, 10 inches, columns, including capitals 25 feet, 11 inches, diameter of columns 6 feet, 10 inches.

The Sybil Temple at Tivoli, near Rome, is most beautifully situated upon a projecting ledge of rocks overlooking the falls, and the valley beyond. It is a circular building 21 feet, 6 inches, in diameter, around which is an open portico, in which originally there were 18 columns, 10 of which remain. It is built of Traverline, which is beautifully represented in the cork model.

The plates, &c., exhibited, are in terra-cotta; they are perfect fac-similes both in color and design, of the Etruscan ware found at Pompei.

JOURNAL
OF
THE FRANKLIN INSTITUTE
OF THE STATE OF PENNSYLVANIA
FOR THE
PROMOTION OF THE MECHANIC ARTS.

JUNE, 1856.

CIVIL ENGINEERING.

*Description of a New Expansive Valve-Motion for Steam Engines.**
By Mr. GEORGE M. MILLER, of Dublin.

The object of the valve-motion described in the present paper (the invention of Mr. John Wakefield, of the Great Southern and Western Railway, Dublin,) is to obtain an expansive action more simple and more perfect than the motion usually employed, the whole motion being obtained from a single eccentric upon the crank-shaft.

The general arrangement of the valve-motion consists of an eccentric, which, instead of being keyed upon the axle in the ordinary manner, is mounted upon a transverse slide, which is capable of being moved at right angles to the axle by means of a handle that takes the place of the ordinary reversing handle or lever. The effect of moving the transverse slide is to alter the throw of the eccentric, or to reverse its position,—thereby enabling the valve of the one engine or cylinder to which it belongs to be worked expansively or reversed. The valve of the second engine or cylinder (in the case of the usual pair, with cranks at right angles to each other,) is worked by a second rod, connected with the same eccentric by means of an arm projecting at right angles to the direction of the first eccentric rod, so as to give to both valves a similar motion, but corresponding to the relative position of the two cranks at right angles to each other.

Upon the crank-axle, and close up against one of the cranks, is fitted a concentric collar, fixed to the axle either by keys, or by screws tapped into the crank-cheek, through lugs cast on the collar on the side next

* From Newton's Lond. Journ., March, 1856.

the crank. On the other side of the collar are cast two parallel beveled slides, situated transversely and equidistant from the centre of the axle. Upon these is fitted a corresponding sliding-frame, carrying a circular ring cast upon it, projecting from its face, which is situated not equidistant between the two parallel slides, but is set eccentrically—that is, nearer to one slide than to the other, by the amount of the minimum throw of the eccentric. The circular ring on the sliding-frame, thus takes the place of the ordinary eccentric, and is fitted with the eccentric strap, on the front edge of which is forged the end of the rod, by means of which the spindle of one of the valves is worked. On the back edge of the eccentric strap, and in the same straight line with the eccentric rod, is forged a slotted arm, having a horizontal slot fitted with a slide block; in which is inserted a pin, projecting from the arm of a loose ring, concentric with the axle, and working in a groove in the fixed collar, which is keyed thereto. This loose ring is furnished with a second arm, at right angles to the arm first mentioned, and also with a balance-weight. To the second arm is attached a rod, similar to the eccentric rod, by which the spindle of the second valve is worked.

The reversing action is effected by means of a crank-lever, which is connected by a strap to a collar that is free to slide along the axle, but revolves with it. This collar carries two racks, which drive the two pinions set at opposite sides of the axle. The pinions are screwed internally to fit on two large four-threaded screws, which are secured in the sliding-frame previously described; and being placed in cavities in the fixed collar, they are incapable of any lateral motion. In reversing the engine, the crank-lever is rocked, and the collar with its racks slides along the axle. This causes the pinions to rotate, and the screws on which they work being held fast in the sliding-frame, a transverse motion is communicated to the frame, which, with the eccentric ring attached to it, is carried along the parallel slides,—thus reversing the position of the eccentricity.

It has to be observed, that with this motion the engine can never be thrown entirely out of gear. When the engine is reversed, the centre of the eccentric describes a chord line, not the diameter of the circle of eccentricity,—and, consequently, the minimum to which the throw can be reduced, is the distance of this chord line from the centre of the axle, or the sum of the lead and lap of the slide; but the same circumstance applies to the ordinary link motion, and although, for this reason, the expansive action of the steam cannot be extended indefinitely, yet practically this is no objection to the valve-motion; since between the positions of maximum and minimum throw, it admits of as great a range for the application of the expansive principle as can be made practically available where the link motion is employed.

In the new valve-motion the lead is constant for all positions of gear; whilst in the ordinary or shifting link-motion it varies to a certain extent with every change of position, increasing as the throw of the valve diminishes; in the new valve-motion, accordingly, the expansive action alone is altered by regulating the amount of throw, whilst the lead is not affected by the change.

A practical trial of this valve-motion has been made in two locomotive

engines on the Great Southern and Western Railway, which have been working with it $1\frac{1}{2}$ and $1\frac{1}{4}$ years respectively, since March and July, 1854. One of these, a passenger engine, is fitted with the new motion as shown in the drawings and model exhibited to the meeting. In the other, a goods engine, a slight modification has been made, the construction being simplified by dispensing with the slotted arm, projecting from the back edge of the eccentric strap, and substituting a similar slot in the eccentric rod; the arm of the loose concentric ring is thus brought round to the front, and the balance-weight is placed behind.

The passenger engine, No. 9, has 15-inch cylinders with a 20-inch stroke, and 5 feet 6 in. driving wheels: it has been working regularly between Dublin and Thurles (a distance of 87 miles), with two other engines, Nos. 17 and 19, by the same maker, and similar in all respects except that they are furnished with the ordinary link-motion.

The results of the working of these three engines during the $1\frac{1}{2}$ year, from the 18th March, 1854, to 12th October, 1855, are as follows:—

	Miles run.	Coke per mile. lbs.	Average load. Carriages.
No. 9,	44,450	20·3	6·0
No. 17,	42,741	23·6	5·9
No. 19,	27,194	24·9	5·8
Mean with link-motion,		24·25	5·85
Mean with new valve-motion,		20·03	6·00

The carriages are six-wheeled, and weigh seven tons empty.

A comparison of the results of the performance of these engines for the periods before stated, shows an average saving in consumption of coke of $4\frac{1}{4}$ lbs. per mile, or $17\frac{1}{2}$ per cent. in favor of the engine having the new valve-motion.

The goods engine, No. 53, has worked well, but the variable character of the work assigned to the goods engines on the above line renders it difficult to compare their performance.

The No. 9 passenger engine has now had it more than $1\frac{1}{2}$ year in constant work. The motion has undergone no repair during the whole time, except that a thin lining of white metal has been recently put upon the face of the beveled slides, which had worn a little slack, having been in the first instance made of brass.

The No. 53 goods engine has been more than $1\frac{1}{4}$ year in constant work with the new valve-motion, and has run during that time 23,581 miles. The motion has had no repairs, and has never even been taken to pieces and examined since first got to work until a fortnight ago; and when the parts were then detached for inspection, they were found in excellent condition, the working faces all in good order, the teeth of the racks and pinions showing no signs of wear, and the whole play of the apparatus amounting to only about $\frac{1}{16}$ th of an inch, being little more than it had when originally set to work.

It may be thought that the application of this new motion encumbers the crank axle with more complex machinery than is the case when four eccentrics are used; but it must, on the other hand, be observed, that the remainder of the space under the boiler is left more free for examination and cleaning; also, the eccentric rods have at all times only the same

extent of motion as the valves, whilst with the link-motion most of the working parts reciprocate over the same space, whether the engine be working expansively or not.

*Notice of the Successful Application of Wood-Bearings to Shaftings, &c.,
in H. M.'s. Screw Steamer Himalaya.*

Southampton, March 17, 1856.

H. M.'s screw steamer *Himalaya* has been docked here during the last week, and we are much pleased to observe that the lignum vitæ bearings applied to her screw shaft, by Messrs. Penn, have worked remarkably well. Since the application of this material the vessel has run about 30,000 miles, during which time the engines have made about 8,000,000 revolutions. The total wear down in the stern-post does not exceed $\frac{1}{8}$ -inch, which is, of course, very trifling for the work done. The screw shaft is lined with brass at the part bearing on the wood, and this bearing is 18 inches diameter $\times$ 4 ft. long. The lignum vitæ is inserted into the cast iron stern pipe in segments, each piece being the whole length of bearing, and about 3 inches wide $\times$ $\frac{3}{4}$ -inch thick, so that the segments combine into the form of the pipe, in a somewhat similar way as the staves of a cask. The abutting edges of these segments are rounded off to form water-ways, and their surfaces are also scored in several places to allow a free circulation of water on every part of them. These segments are prevented from running round with the shaft through its friction by a strip of metal, which is pinned on to the upper side of the stern pipe, and against the edges of which the lignum vitæ segments abut. They are kept in at the inner end by a shoulder in the stern pipe, and at the outer end by a ring, which is screwed on to the stern post.

We are indebted to the courtesy of Mr. Gray, the engineer of the *Himalaya*, for a description of a very ingenious application of lignum vitæ which he has adopted in his collar or thrust bearing. He found this bearing wore considerably, and when in the Mediterranean last year, the brass rings had thus become so reduced that there was a space of about $\frac{3}{4}$ -inch on the slack side of the collars. He determined to try the experiment of interposing lignum vitæ segments between the thrusting collars on the shaft and the brass rings on the bearing, and fitted them in four segments of a circle to each collar, so that they can be slipped in their place without removing the bottom brass. They are prevented from running round with the shaft by a brass plate screwed on to the lower brass, and are so easily removed and refitted that two hours only are necessary for applying new segments to the block.

Mr. Gray finds that a set of lignum vitæ segments, thus applied, will last for from 7000 to 10,000 miles, and the expense of fresh wood segments is very trifling.

We think that this plan is a very happy illustration of the old adage of "Necessity being the Mother of Invention," and doubt not that many of our sea-going readers will thank Mr. Gray for his novel application of materials.

* From the London Artizan, April, 1856.

Mr. Gray informs us that when the *Himalaya* has a clean bottom, and is in ordinary weather and without sails, she runs 1 mile with 250 revolutions of engines; but when her bottom becomes foul, from seven or eight months' running, it requires 300 revolutions of engines per mile run. This gives a slip of screw amounting to about 13 per cent. in one case and $27\frac{1}{2}$ per cent. in the other, and shows what a dirty bottom will do in stopping the progress of an iron ship, and the great desideratum for some material which will arrest this fouling.

*On the Relative Proportions of the top, bottom, and middle webs of Iron Girders and Tubes.** By Mr. HEPPLÉ, M. Inst. C. E.

The object of the paper was the investigation of the forces to be resisted by the middle webs of girders.

The first part of the inquiry had reference to the case of a plate of metal subjected to the action of various direct forces,—some compressible and others tensile,—simultaneously applied to it, in different directions; and it was shown that these might always be resolved into two principal resultants, which were invariably at right angles to each other; and by which the applied forces, however numerous, might be conceived to be replaced—the condition of the plate being absolutely the same, whether considered as subject to the forces originally applied, or to their two principal resultants.

The next point was the consideration of the condition of a rectangular plate, held in equilibrium by lateral forces, applied in couples, uniformly distributed along its sides; and it was shown, that in this case also, there were two principal resultants,—one tensile and the other compressible,—that these two were of equal intensity, at right angles to each other, and at angles of 45° with the applied forces: moreover, that their intensity was exactly equal to that of the applied lateral forces.

It was next shown, that the middle web of a girder exposed to a load, at a given point, was exactly in the condition of the plate last considered, and a rule for the computation of its thickness was arrived at.

Other cases of the distribution of loads, both fixed and movable, were then considered, and rules for the corresponding thickness deduced.

The effect of the horizontal strains to which the middle web was subject, was then considered, and an investigation was made of the magnitude and direction of the resultants arising from their composition with the diagonal forces before considered.

Finally, the increase to be made in the thickness of the middle web, beyond that already arrived at, in order to enable it to deal with these horizontal and diagonal strains together, was investigated, and a rule was deduced for its definite determination.

The results arrived at were briefly these:—Four different cases of distribution of the load being considered, and, in the first instance, the hori-

* Read before the Institution of Civil Engineers; London, Jan. 15th, 1856.

zontal forces being left out of consideration, and the thicknesses determined with reference to the diagonal forces only. These four cases were,—

1. That in which the load was fixed and central.
2. That in which a load concentrated on a point, moved along from one end of the beam to the other, as the case of a concentrated roller load.
3. That in which the load was fixed and uniformly distributed.
4. That in which a load, uniformly distributed, was drawn on from one end, or that of a distributed roller load.

It was then shown, that in order to enable the middle web to deal with the diagonal strains, its thickness should be determined by the following methods:—

In the first case,—the fixed central load,—by making it of uniform thickness, and such that its horizontal section was equal in area to the central vertical sections.

In the other three cases the thickness of the middle web, at the extremities, was twice that determined as above. In all of them it diminished towards the centre, but in each case according to a different law.

In the second case,—the concentrated rolling load,—the thickness varied as the distance from the more remote extremity.

In the third case,—the distributed fixed load,—the thickness varied as the distance from the centre.

In the fourth case,—the distributed rolling load,—the thickness varied as the square of the distance from the more remote extremities.

The cases of combinations of these kinds of loads were then considered, and it was shown, that by dividing the central vertical section into portions proportional to the amount of each kind, and thence determining the thicknesses from the middle web for each kind, according to its own law—the sums of the thicknesses, so determined, would give those necessary for dealing with the compound load.

The effect of the horizontal forces was next considered, and two cases were taken: first,—that in which the section of the beam diminished from the centre towards the extremities, in the ratio of the rectangle of the segments of the length,—in which case the horizontal forces were constant, or nearly so, throughout.

In this case it was shown, that the thicknesses, as before determined with reference to the diagonal forces alone, should be trebled, in order to fit them to resist the resultants arising from their composition with the horizontal forces; and, as in all beams, where any variation whatever was made in the vertical section, it did, or should approximate to the above law. It was considered, that this rule should be taken as applicable to beams of variable section.

For beams of uniform section, it was shown, that the thickness of the middle web should be such, that the horizontal section should be three times the vertical area.

The stiffening of the sides was then considered. It was argued, that as the efficiency of the stiffening must, in some way, depend on the amount of area, compared with the amount of support applied to it, it might reasonably be supposed to be proportionate to a line which would form a web to the rectified periphery,—a rectangle equal to the area to be

supported,—which line (borrowing a phrase from hydraulics), might be called “its mean radius.” Reasons were then adduced, for believing that stiffening pieces might, with safety, be so distributed, as to leave the mean radius of the included spaces equal to seventy times the thickness of the plate ; although, in most early structures, it would be found to be much less than what would result from such a calculation.

*Canal through the Isthmus of Suez.**

It will be gratifying to all who have taken an interest in the practicability of opening up a ship canal between the Mediterranean and the Red Sea, to learn from the Report of Investigation, by the engineers who have recently been engaged on the survey, that no engineering difficulty presents itself to the carrying out of the project between Suez and Pelusium. It will be remembered that this is the line proposed by Mr. Lesseps—the particulars of which he detailed, in a work extensively circulated—about nine months since. The capital required will be about six millions ; and if the money market continues to improve, the undertaking will be brought in an organized form before the public.

“For the moment we give,” say the Commission, “the following conclusions :

“1. The line on Alexandria is not admissible in a technical and economical point of view.

“2. The direct line offers every facility for the execution of the maritime canal, properly so called, with a branch to the Nile, and the usual difficulties for the creation of the two ports.

“3. That of Suez will open upon a large and sure roadstead, accessible at all times, with eight metres of water at 1600 metres from the shore.

“4. That to be formed in the Gulf of Pelusium, which the first plan placed at the end of the Gulf, will be placed 18 kilometres more to the west, where there are eight metres of water at 2300 metres from the shore, with good anchorage.

“5. The expense of the canal of the two seas, and of the works connected with it, will not exceed the sum of 200,000,000 francs, as put down to the estimates of the engineers of the viceroy.

“The members of the International Commission for cutting a canal through the Isthmus of Suez—

“F. CONRAD, *President*,
“NEGREL,

A. RENAUD,
J. M'LEAN,
LIEUSSEON, *Secretary.*”

From the Lond. Mech. Mag., Jan., 1856.

AMERICAN PATENTS.

List of American Patents which issued from April 1st, to April 22d, 1856, (inclusive,) with Exemplifications.

APRIL 1.

1. For *Improved Self-inking Stamps*; Nathan Ames, Saugus, Mass.

Claim.—"In combination with the frame and shaft, the arrangement of devices by which the type or printing surface is inked, and the impression produced by one downward motion of the hand, or other power, applied to the perpendicular shaft—the inking roller (being acted upon by two forces, the perpendicular and diagonal,) moving first over the bottom of the type block, and then over the back side of the same."

2. For an *Improved Lubricator*; Edward J. Baker, Baltimore, Maryland.

Claim.—"The combination of the reservoir with the vertical stem or spindle, by means of the conical sockets and bearings in the upper and lower parts of the reservoir, together with the passages or openings, which are in said sockets and bearings, for the admission and discharge of the oil or lubricating fluid, and also for the escape of the air from the reservoir while oil or fluid is being poured into it—the said passages being alternately opened and closed, by rotating or moving the reservoir around, or partly around the central stem or spindle."

3. For an *Improved Bench Vise*; Benjamin G. Ball, Nashua, New Hampshire.

Claim.—"Combining the rotary shaft and the shanks of the jaws, the tubular screw connexion and the clutch, when a rotary shaft is made to actuate the jaws."

4. For an *Improvement in Making Seamless Metal Tubes*; William F. Brooks, City of New York.

Claim.—"The grooving or removing the carriers of the rollers, so that a series of parallel projections or ribs, will be formed upon the tube; the rollers relieved from understrain, protected from choking, and the reduction of the tube and the withdrawal of the mandrel therefrom facilitated."

5. For an *Improvement in Rolling Railway Bars*; John W. Brown, Mt. Savage Iron Works, Maryland.

Claim.—"So forming one or more of the grooves of the rollers, as to produce a depression or cavity, all along that side of the bar which is to form the base of the rail, previously to the reduction of the bar to form the neck; said cavity to be filled up by the displacement of the iron from the middle of the rail, by the subsequent rolling operation."

6. For an *Improved Apparatus for Removing Grain from Harvesters*; Samuel Comfort, Jr., Morrisville, Pennsylvania.

Claim.—"1st, The employment in harvesters of the grated platform and radial grating, the same being constructed and operated in conjunction with each other. 2d, The radial grating with its two rollers, shaft, and arm, as connected to the shaft, in combination with the curved plate and its curved recess, for the purpose of turning over the said radial grating, and clearing it of the grain or grass. 3d, The arm with its projection recess, jointed inclined plane, in combination with the shaft, its cranked portions, and roller, for the purpose of giving the grated platform the desired vertical movement."

7. For an *Improvement in Breech Loading Fire Arms*; Hezekiah Conant, Hartford, Connecticut.

Claim.—"The inserting a metal ring into the slide with the chamber in rear of said ring."

8. For an *Improvement in Steam Boilers*; F. P. Dimpfel, Philadelphia, Penn.

Claim.—"The arrangement of the tubes and the connexion of a receptacle for consuming the fine particles of coal, which are carried by the force of the blast or draft, from the fire chamber into the flues, the said receptacle being placed below the bottom of the main flue, and communicating therewith and between the fire chamber, and a check or deflector in the main flue, to check the momentum of the particles of coal, and cause them

to drop into the receptacle to be consumed. Also, the combination of the boiler forming a single flue in the middle, for the passage of the products of combustion from the main flue surrounding the water tubes to the smoke box, by securing the rear ends of the water tubes to two tube sheets—one-half to each of said tube sheets, and leaving a space between the two tube sheets for the passage of the said middle flue, when this is connected with a check or deflector, placed in the main flue among the water tubes and in front of the said middle flue, to prevent the products of combustion from taking a direct course to the said middle flue. Also, arranging the bent up ends of the water tubes, when they are connected with the crown sheet of the furnace, in a series of double longitudinal rows, and leaving spaces between the double rows of greater width than the external diameter of the water tubes, to admit of taking out and inserting the tube, whilst, in other respects, the said tubes may be placed as near to each other as may be desired."

9. For an *Improvement in Grain Harvesters*; Augustus Elliot, San Francisco, Cal.

Claim.—"1st, Forming the cut grain into sheaves or bundles, by means of a series of endless bands and rollers, having an intermittent motion. 2d, 'The spring apron.'"

10. For an *Improved Hydrant*; Henry English, Baltimore, Maryland.

Claim.—"The combination of the square shanked valve and its seat, with the cap piece."

11. For an *Improved Printing Press*; George F. Folsom, Roxbury, Mass.

Claim.—"1st, The method of giving the impression with the two plates, by means of the gear and double cranks. 2d, The method of feeding two sheets into the nippers, by means of the binder, in combination with an intermittent feed."

12. For an *Improvement in Cloths for Felting Hat Bodies and other articles*; William Fuzzard, Charlestown, Mass.

Claim.—"The employment or use of a corrugated apron, constructed of any proper material."

13. For an *Improvement in Journal Box for Railroad Car Axles*; William B. Gage, Louisville, Kentucky.

Claim.—"In a railroad box, made with the cap box secured to the lower or main box or cell, which latter is formed to receive an inner box or cell, to contain cotton wash and oil, or other lubricator, is making in this combination, the inner box or cell with projecting lips, which embrace the lower half of the journal, to fit and slide in recesses in the sides of the brass or cap box, so that when the journal is inserted, and the inner box or cell is forced up against the journal by the springs, the whole circumference of the journal shall be embraced, to prevent the entrance of dirt and waste of oil, and yet permit the inner box or cell to approach the upper box as the surfaces wear—the fitting of the lips of the inner cell within the recesses of the cap box, permitting the two to approach and recede from each other without a break, for the escape of oil in the circle of the surfaces which embrace the journal."

14. For an *Improved Method of Manufacturing Augers*; George G. Griswold, Chester, Connecticut.

Claim.—"The form of the plate required for making the twist to the auger or bit."

15. For an *Improvement in Automatic Steam Whistles in Locomotives*; James Harrison, Jr., Milwaukee, Wisconsin.

Claim.—"The apparatus consisting of the spirally slotted or grooved cylinder, for connexion with and operation by the locomotive, detachable and adjustable lifters, of varying thickness, length or breadth, and lever, or its equivalent, in combination with, and for operation on the whistle."

16. For an *Improvement in Slide Rests*; Albert V. Hill, Hinsdale, New York.

Claim.—"The use of the slide mortise, driving screw, arranged and operating in connexion."

17. For an *Improved Mortising Machine*; Edward Joslin, Keene, New Hampshire.

Claim.—"Combining or arranging with the tri-armed sectional lever, and the post or frame of the tool carriage, two wooden springs and a connecting rod, so that one spring may be separated by draft, and the other by pressure, when said lever is placed downward."

18. For an *Improved Life Boat*; George W. La Baw, Jersey City, New Jersey.

Claim.—"Arranging the carriage or inner boat upon pivots, so as to allow the outer boat to rotate over and around the inside boat or carriage, which always retains an upright position."

19. For an *Improved Former for Spiral Springs*; Vincent D. Lent, Chelsea, Mass.

Claim.—"A former, constructed with suddenly expanded ends."

20. For an *Improvement in Spark Arresters*; StimmeLutz, Philadelphia, Penna.

Claim.—"The combination of the plates, branch pipe, and the cap or reservoir, provided with a central cavity, or its equivalent, in its upper end."

21. For an *Improved Method of Converting Reciprocating into Rotary Motion*; Robert Maffitt, Bradford, Pennsylvania.

Claim.—"The arrangement of the laterally projecting lifting teeth, on the semi-pinions, in combination with the guide grooves and lozenge projections."

22. For an *Improved Mitering Bench*; J. W. Mahan, Lexington, Illinois.

Claim.—"The peculiar construction of the mitre box, the advantages it possesses over, any other in use, being, 1st, so constructed, that it never wears out by the teeth of the saw cutting the box, as in the case in ordinary boxes; 2d, its easy combination with the other devices in my machine, for accomplishing the various results, which can be accomplished perfectly by any one, whether skilled or not, in the ordinary way of accomplishing said results, to wit: laying off and cutting picture frames, door and window frames, tenoning sash, &c. Also, its combination with the other device, as shown by my model drawings and specification."

23. For an *Improved Machine for Gathering Seeds or Grain in the Field*; Thomas E. Marable, Petersburg, Virginia.

Claim.—"In combination with a gatherer for drawing in the heads, the rubbing boards having a vertical movement for receiving the heads under it, and then dropping down, and having a transverse rubbing motion, for rubbing out the seeds or grain."

24. For an *Improvement in Wrenches*; Philip McManus, Brunswick, New York.

Claim.—"The cam or eccentric, attached to the sleeve, and the rack attached to the sleeve by a spring, in combination with the rack on the shank. Also, in combination with the cam or eccentric and racks, the finger piece."

25. For *Improved Wind Wheels*; Francis Peabody, Salem, Massachusetts.

Claim.—"The method of hanging and arranging the two wheels, and adapting them to the opposite ends of a permanent building; the wheels with their regulating disks being secured to the revolving turn tables, at a distance from the point around which they revolve, equal or nearly so, to one-half the width of the building, whereby wheels of great diameter may be employed, in combination with a permanent building of any required dimensions. Also, the weights and pipe, with the chains, or their equivalents, in combination with the disks, for the purpose of regulating the motion of the wheel to the varying force of the winds."

26. For an *Improvement in Soldering Wire Ferrules*; Asahel Pierpont, New Haven, Connecticut.

Claim.—"The employment of the jaws, with the cone and foot, or their equivalents."

27. For an *Improved Instrument for Stirring Straw and Husk Beds*; Calvin A. Richardson, Waterville, Maine.

Claim.—"The mode of constructing said instrument for the purpose of stirring filling in beds."

28. For an *Improvement in Forge Fires*; William Rodgers and Abraham Bannon, Bellefonte, Pennsylvania.

Claim.—"The forge hearth, when employed in connexion with the tuyeres, operated by the lever."

29. For an *Improved Method of Varying the Stroke of Feeding Pump for Steam Engines*; John R. Lees, City of New York.

Claim.—"The use of an intermediate arm or lever, between the moving power that works a force or supply pump, attached to a steam boiler and the pump, with an adjustable sliding block, movable on said arm or lever."

30. For an *Improved Wheelwright Machine*; John Siltou, Williamston, N. C.

Claim.—"1st, The double faced wheel working upon an axle, and made strong by flanches on the axle, upon which the blocks from which the fellows are cut, are secured by the clamps. 2d, The construction, operation, and use of the clamps. 3d, The construction, arrangement, and operation of the knives or cutters. 4th, The construction and operation of the grooved wheel. 5th, The fellow metre. 6th, The arrangement of a carriage or other wheel to the finishing wheel."

31. For an *Improved Lathe*; Henry C. Spaulding, City of New York.

Claim.—"1st, Attaching the cutter heads, by having the shanks of said cutters fitted in taper grooves which are made in the sides of the cutter heads, the inner ends of the grooves being wider than the outer ends, to permit the proper adjustment of the cutters. 2d, The shaft, when arranged so that it will rise and fall curvilinearly, and be at equal distances from the arbor or shaft, at any point of its movement, so that power may be applied to the gearing which operates the adjustable and reciprocating carriage from the stationary arbor or shaft, without changing the lengths of the driving belts. 3d, Holding or securing the sticks to be operated upon, by means of the jaws, operated by the grooved drum, lever, and plates. 4th, The hub arm with pawls attached, and operated for the purpose of rotating or turning the sticks the requisite distance between the centres, at each movement of the carriage, so that the sticks may be cut with any desired number of sides. 5th, Arranging the belt shipper with a hooked lever and pendant lever, and spring, and having a projecting pin attached to the side of the hub, so that the driving belt of the machine will be thrown off the driving pulley, at each entire revolution of the hub, so that the finished work may be removed from the machine, and fresh sticks placed between the centres."

32. For an *Improvement in Axle Boxes for Carriages*; Ezra M. Stratton, City of N. York.

Claim.—"Plain longitudinal channels across the enlarged portion of mail axle boxes, adapted to, and in combination with long bolts, for fastening carriage wheels upon mail axles, by which combination, the long bolts are brought close to the small portion of the box, and the whole so compactly grouped together, as to adapt mail axles and boxes, and long bolts to small hubs, such as are now required for light and fashionable carriages. Also, the combination of plain, longitudinal channels, made across the enlarged portion of mail axle boxes, with reverse channels made in corresponding portions of the hub, when the bars and hub are fitted for, and combined with the long bolts acting therein as keys between the box and hub, for the purpose of securely fastening the box in the hub, by means of the long bolts, which thus perform the functions of keys and dispense with the necessity for injuring the hub, by splitting and wedging the same, as has heretofore been necessary in all cases for fastening axle boxes in carriage hubs, whereby I preserve the whole strength of the hub, and materially cheapen the cost and labor of fitting and fastening the box therein."

33. For an *Improvement in Valve Gear of Oscillating Engines*; William Stephens, Pittston, Pennsylvania.

Claim.—"The arrangement of the slotted plate in the slide, or its equivalent, for the purpose of adjusting and varying the lead of the valve."

34. For an *Improved Field Fence*; S. G. Turfts, Wainessville, Ohio.

Claim.—"Constructing fences in distinct and separate sections, connecting the same by adjustable links and wedges at their upper corners, and supporting said sections by chains placed between and at right angles thereto."

35. For an *Improvement in Grain and Grass Harvesters*; George W. N. Yost, Pittsburgh, Pennsylvania.

Claim.—"The combination of the racks and king bolt, arranged for adjusting the cutter bar of harvesters."

36. For an *Improvement in Door Springs*; Alvin Barton, Assignor to self and A. R. Morgan and J. M. Parsons, Syracuse, New York.

Claim.—"The employment of the eccentric cog wheels, in combination with the coiled spring, lever, and guide rod, attached to the door or gate."

37. For an *Improvement in Bridges*; George W. O. Huggens, Assignor to self and Charles Bender and D. F. Tiedman, St. Louis, Missouri.

Claim.—"The combination of and between those mechanical agencies and technical

parts which constitute the mode to prevent vibration in a bridge by using the compensated effect of compression only. Also, the combination of and between the mode in which the arches are arranged, and across each other, and the mode in which they are connected with the flow; and, finally, the mode in which they receive their leverage, the mechanical effect of which said combination is to originate the tendencies in the upper and lower arches to curve apart or asunder. Also, the combination of and between the mode in which the arches cross each other, and the mode in which they are connected with the floor; and the mode finally, in which they are constructed, in regard to amount of material, the mechanical effect of which said combination, is to originate the equal intensity of the said tendencies. Also, the employment in the bridge construction of the arches, as a practical substitute for upper cords, and generally, for all such parts in bridges, which serve to uphold the floor. Also, the special mode in which the arches are connected with the floor."

38. For a *Machine for Making Carpet Lining*; John R. Harrington, Dayton, Ohio.

Claim.—"1st, The arrangement of the horizontal spindles or rollers, on which the outer sheets or rolls of paper or cloth are wound, in combination with the intermittent spindle on which the inner layer of cotton or other filling is wound. 2d, The arrangement of the rolls, in combination with the spindles. 3d, The troughs that contain the size or mucilage, and the brushes that administer it, when used in combination with the spindles. 4th, The creasing rolls, when used in this connexion, each having alternate grooves and ridges, at their requisite distance for the folds, for the purposes of folding and measuring. 5th, In this connexion, the box or platform, placed below the delivery of the rolls, and having a falling front."

39. For *Improved Skates*; Fernando Klein, Newark, New Jersey.

Claim.—"The iron bar, attached to the heel plate, and having two knobs."

40. For an *Improved Fishing Lead*; Wooster Smith, South Thomaston, Maine.

Claim.—"The improved shape of my lead; the improved mode of fastening the long part of the fish line to the swivel in the top of the lead; the cap of iron, brass, or other hard metal, on the bottom, or descending end of the lead; the horse line running through the lead at the bottom end, the swivels and rings attached to the ends of said horse line, to which rings of the swivel, the small lines to which the hooks are attached, and said swivel in the top of the said lead, to which said long part of the fish line is fastened."

APRIL 8.

41. For an *Improvement in Machines for Drying Wet Grain, &c.*; Stephen V. Appleby, City of New York.

Claim.—"The application of revolving cylinders, situated in a heated flue, with their ends projecting into flues into which cold air is forced, and so arranged, that grain or other similar substances, put into the top cylinder, will slide through the same, and then fall into the next cylinder, and so on from one to the other, being in its passage alternately subjected to the action of heat, while in the cylinder, and to the action of cold air, while falling from one cylinder into the other."

42. For an *Improvement in Enclosing Propeller Shafts in Keels*; Aaron Arnold, Troy, New York.

Claim.—"The manner of enclosing propeller shafts in keels made of sheet iron, or other material, fastened to the vessel's bottom."

43. For an *Improvement in Looms*; Erastus B. Bigelow, Boston, Massachusetts.

Claim.—"Connecting the tension roller, or its equivalent, with the let-off motion, to regulate the delivery of the warps by the arm or feeder. Also, the devices for holding the tension roller, or its equivalent, firmly at the beat of the lathe. Also, the mode of constructing the belt cam, and combining it with the shipping lever. Also, the mode of connecting the friction brake with the shipper and stop motions of the loom. Also, releasing the said friction brake, to allow the loom to be turned by hand."

44. For an *Improvement in Cooking Ranges*; John Plant and Charles G. Ball, Washington, D. C.

Claim.—"The arrangement of the fire chambers, ovens, and front plate, in such relation to each other, as to admit the products of combustion to pass through the flue, over the top plate of the oven, thence down through the flue in front of the fire chamber to the flue beneath the oven."

45. For an *Improved Waste Attachment for Hydrants*; Edward J. Baker, Baltimore, Maryland.

Claim.—"The application to a hydrant of the receiving chamber and piston."

46. For an *Improvement in Pressure Bells*; Jason Barton, Middle Hadam, Conn.

Claim.—"So suspending the hammer, by a point near the top of the bell, but out of the centre thereof, as that the said hammer shall swing from a point near the edge of the bell into the top part of the interior of the bell, and vice versa, thus allowing it a downward velocity and a very long movement, and, at the same time, allowing it to strike the bell near the edge, and at right angles, or nearly so, to its surface."

47. For an *Improvement in Door Fasteners*; G. H. Lindner, Hoboken, New Jersey.

Claim.—"The two catches, provided with hooks or curves at their ends, which hooks or curves pass around the pin attached to the sill or lintel of the door or window frame, the catches being fitted within the case, which is attached to one of the doors or windows; the catch being provided with projections, against which, the bar attached to the other door or window, acts."

48. For an *Improvement in Fastening Door Knobs*; Nathan Benham, Hartford, Connecticut.

Claim.—"In securing the shaft to door knobs in the use of the slotted shaft, with the wedge-shaped hole; said shaft being opened by a screw, or its equivalent."

49. For an *Improved Machine for Combing Seed off Broom Corn*; George E. Burt, Harvard, Massachusetts.

Claim.—"The combination of the wheel, or its equivalent, (such as a rim or a circle,) having one or more rows of teeth in its periphery, with one or more cylinders placed parallel, or nearly so, with the plane of the wheel. Also, the bar. Also, the spur roller, in combination with the plate."

50. For an *Improvement in Shot Guns*; George Buckel and Edward Dorsch, Monroe, Michigan.

Claim.—"Giving the bore the undulating form."

51. For an *Improvement in Magneto-Electric Machines*; Calvin Carpenter, Jr., Providence, Rhode Island.

Claim.—"The cut-off, consisting of the geared segments, and gear wheels or wheel, and thus serving the purpose of springs, and driving a revolving prism, or its equivalent, for rapidly breaking the current."

52. For an *Improvement in Rotary Pumps*; Thomas Crane, Fort Atkinson, Wis.

Claim.—"Connecting the shaft to the hub, in such manner, that without opening the pump case, the periphery of the annular piston can, at any moment, be forced outwards into close contact with the periphery of the pump chamber."

53. For an *Improved Sash Fastener*; Thomas J. Crooke, City of New York.

Claim.—"Combining with the bolt of a self-acting latch, an engaging and disengaging catch."

54. For an *Improved Tempering Furnace*; Robert B. Fellows, Shelburne Falls, Mass.

Claim.—"The combination of the plate and the tubes, with a single fire."

55. For *Improved Flood Gates*; George W. Flanders, Lynn, Mass.

Claim.—"Constructing the gate of one part, and hanging or hinging its lower end to the apron or bottom of the flume."

56. For an *Improved Vise*; Orlando V. Florey, Yellow Springs, Ohio.

Claim.—"The use of the ratchet brace, operating in connexion with the ratchet, sliding beam, and movable jaw."

57. For an *Improved Machine for Planing Felloes*; A. W. Fox, Athens, Penna.

Claim.—"The arrangement of the movable pinions, gearing respectively into the series of cogs on the crown wheel, in combination with the device for gearing and un-gearing said pinions at the proper moments, whereby the carriage is automatically fed along slowly, then returned at a more rapid rate, and finally stopped, while the cutters

continue to revolve with uniform motion. Also, the combination of the clamping apparatus with the lever, arms, and spring, for the purpose of automatically releasing the fellows. Also, the device for throwing the fellows from the machine."

58. For an *Improvement in Piston Valves for Steam Boiler Regulators*; William S. Gale, City of New York.

Claim.—"The lip of the piston cap, and the spring, arranged in relation to each other and to the piston body, for the purpose of clamping the packing."

59. For an *Improvement in Machines for Polishing Leather*; William P. Gamble, Philadelphia, Pennsylvania.

Claim.—"Effecting the rectilinear motion of the flint or glass, when in contact with the leather upon the strap, by means of the compensating devices."

60. For an *Improvement in Carriage Coupling*; William Greenleaf, Greenfield, Ohio.

Claim.—"The application of the moving rods, the circular T plate, and half circle."

61. For an *Improvement in Submarine Lanterns*; Charles M. Gould and Charles B. Lamb, Worcester, Mass.

Claim.—"1st, The two concentrically arranged glass cylinders, having an air space between them. 2d, The air chambers, with the communicating perforations and spring valves, in combination with the feed and escape pipes."

62. For an *Improvement in Machines for Sifting Coal and other Articles*; Samuel Harris, Springfield, Mass.

Claim.—"The providing of the pins on the underside of the cover of the sifting box, in such relation to the bottom of the vibrating sieve, that when the top of the box is closed, and the sieve vibrated back and forth, they shall separate the material being sifted, and thus improved, and facilitate the sifting operation; and when the top of the box is opened, they shall be out of the way, and thus allow for the convenient removal and replacement of the sieve."

63. For an *Improvement in Processes for Extracting Oil from Cotton Seed*; Augustus A. Noyes, Boston, Mass., Assignor to George Ashman and Charles Phelps, Springfield, Mass.

Claim.—"The maturing of the cotton seed, after it has been separated from the cotton, by heat artificially applied, so as to render the husk brittle and easily separable from the kernel."

64. For an *Improved Arrangement of Slide Valves and means for Operating them*; William N. Henderson, Baltimore, Md.

Claim.—"The arrangement of the valves, and the means for operating them, by which the entire exhaust is controlled by a non-pressure valve, enclosed and working within the balanced cut-off induction slide valve, and worked by separate mechanism, in the same plane; the time or cut-off and exhaust being variable at pleasure, and in no way connected or affected by the movement or operations of each other."

65. For an *Improved Machine for Tapering Whalebone for Whip Handles*; Livera Hull, Charlestown, Mass.

Claim.—"Confining with the cutter cylinder, and the bed plate of the machine mechanism to operate against, and be operated by the sides of a stick of whalebone, and so as to control or regulate the vertical movements of the rotary cutter cylinder. Also, constructing the cutter cylinder and combining it with the plate."

66. For *Improvements in Machines for Mixing Lime and Sand for Mortar*; Henry W. Hunt, Peekskill, New York, and John Sands, Greenwich, Conn.

Claim.—"The combination of the annular bed and wheel, attached to the rotating and drag."

67. For an *Improvement in the Construction of Envelopes*; Robert T. Knight, Philadelphia, Pennsylvania.

Claim.—"The lapping and interlacing of the ends, and the full width, the back being the full width and length, turning over the enclosed letter, so that when the clasps are in, it is impossible to open it without detection. Also, the application of the metal clasps to the envelope and letter, or both together, making it one and the same parcel, for the

better security of the contents, and also to fix the date of mailing the enclosed letter, which is highly important in many legal and public documents."

68. For an *Improvement in Locks*; William Maurer, City of New York.

Claim.—"The tumblers, having slots made in them, in combination with the slotted bolt, bolt catch, arm or lever and bit."

69. For *Automatic Thermo-hydro-Olaio Pneumatic Valve*; Earl Parker and Wm. Reynolds, East Hartford, Conn.

Claim.—"The employment, when combined of oil and water, or their equivalents, for the automatic closing or moving of the valve, by expansion of the said fluids in their liquid state. Also, the arrangement of the inner and outer bells, tubes, perforations of passages and interior piston or valve."

70. For an *Improvement in Door Locks*; Andrew Patterson, Pittsburgh, Penna.

Claim.—"The use and employment of a vibrating bolt, which shall act as a brace between the seat in, or shaft on which it vibrates, and the jamb piece or keeper, into which it falls, without any other leverage, or any other point."

71. For an *Improvement in Charring Wood*; Sanford S. Perry, County of Charles City, Virginia.

Claim.—"The process or mode of charring wood, or, as it is commonly called, "burning charcoal," by the application of hot or heated air to the wood to be charred."

72. For an *Improved Governor Valve for Steam Engines*; H. H. Smith, Cincinnati, Ohio.

Claim.—"The self-adjusting rings and combined with the eccentrics, or their equivalents.

73. For an *Improvement in the Felt Guide of Paper Machines*; P. H. Wait, Sandy Hill, New York.

Claim.—"The employment and use of two crooked levers, hung upon pivots, and operated by connecting rod and guide pins or friction rollers, against which the felt bears, working the rod and levers, changing the position of the roll, by action of the felt."

74. For an *Improvement in Boilers for Cooking by Steam*; Edward Whiteley, Boston, Massachusetts.

Claim.—"The trap and cap, as arranged and applied to the vessel, whereby the latter may be employed either as a boiler or a steamer."

75. For an *Improved Method of Treating Surface Springs*; Anson Wolcott, East Bloomfield, New York.

Claim.—"The use of an inverted vessel, constructed with an edge susceptible of being forced into the clay pan through which the spring issues—said vessel being provided with a discharge pipe, for the purpose of capping springs, so as to admit of surrounding and covering the inverted vessel with clay."

76. For an *Improved Slate Frame*; Edwin Young, Philadelphia, Penna.

Claim.—"A slate frame, made of a single piece of wood, provided with a groove, to receive the edge of the slate, and bent so as to fit it with the ends fastened together."

77. For an *Improved Machine for Making Envelopes*; William W. Cotton, City of New York.

Claim.—"1st, Operating the feeding, gumming, partial and complete folding, pasting and delivering devices, from two shafts, so united that the rotary motion of one shall give a rocking motion to the other. Also, the feeding up of the blanks, by the two feeding plates—each one carrying it up a portion of the distance, and delivering it against the stops or guides, from whence it is carried through the machine and completed. Also, the combined operation of the paste box and pasters, the former operated from the rock shaft, and the latter from the revolving one through the intervention of devices. Also, in combination with the block, the folders, the hinged joints of which are covered, and the swell of the hinges facing each other. Also, in combination with the holders, the sliding cam plates, with their several connexions for operating said folders."

78. For an *Improved Method of Regulating Pumps by Wind Wheels*; Jacob W. Goodwin and Moses C. Hawkins, Edenborough, Penna.

Claim.—"1st, The construction of a wind wheel, with the sails shaped like a funnel and always presenting the open ends of those on one side of the wheel to the blast. 2d, The construction of the float and the lever, with the elevating rod, in combination with the wheel, so constructed as to be raised and lowered, by the rising and falling of the float."

79. For an *Improved Arrangement of Valves for Hydraulic Engines*; John D. Heaton, Dixon, Illinois.

Claim.—"The construction, use, and application. of the swinging or vibrating band, valve devices hung on or attached to an axle or shaft, and operated by the slotted connexion rod and wrist pins. Also, in combination with the said valves, the construction and arrangement of the water chests, or the chambers and the compartments, with the pipe."

80. For *Improved Basin Cocks*; Charles Harrison, City of New York.

Claim.—"The screw plug and its valve, actuated by the bent pipe, when combined with the stop."

81. For an *Improvement in Machines for Sowing Seed Broad Cast*; Jesse Lincoln, Uniontown, Pennsylvania.

Claim.—"In combination with the hopper, the seeding roller, provided with open cells passing through it, and rocked through the hopper, to receive and discharge the grain broad cast."

82. For an *Improvement in Corn Planters*; Edward P. Lacey, Rochester, New York.

Claim.—"The annular rim, having inclined projections attached to it; the projections fitting or working over projections on the back of the groove, the toothed rim being placed over the rim."

83. For an *Improved Machine for Polishing Buckles*; Robert G. Pine, Sing Sing, New York.

Claim.—"The combination of the polishing and guide wheels, with the rotating and longitudinally moving shafts, provided with clamps, the shafts working in yielding or elastic bearings."

84. For an *Improved Spoke Shave*; Martin Snow, North Bridgewater, Mass.

Claim.—"My new or improved manufacture of a heel or spoke shave knife, made of one piece of steel, and with both of its starts bent or formed in the shape of springs."

85. For an *Improved Machine for Bending Wood*; Edward J. Updegraff, York, Pennsylvania.

Claim.—"The peculiar method of operating the form upon which the wood is bent, by bringing it hard down upon the platform by means of the screws, and giving it motion by means of the platform beneath it, (whether endless chain or otherwise,) separately and in connexion with the arrangement of the wheels, the screw, the spring, the frame and the slide."

86. For an *Improved Core Bar for Pipe Moulding*; John Demarest, Assignor to The J. L. Mott Iron Works, Mott Haven, New York.

Claim.—"Making core bars for moulding curved, elbow, or branch pipes, and other such like hollow castings, with sustaining plates or rings at the ends."

87. For an *Improvement in Wash-Boards*; Royal Hatch, Assignor to Henry C. Hatch, Stafford, Vermont.

Claim.—"The beaded rounds, when secured in the frame of the board, viz: by having tenons on the ends of the rounds, fitted in the grooved rails, and the beads of every alternate round fitted in the cavities or hollows of the intermediate rounds."

88. For an *Improvement in Boxes for Axles*; Julius Bevin, Assignor to self and Saml. N. Stillman, Unandilla Forks, New York.

Claim.—"The new manufacture of hub box for wheels, which turn upon their axles, to wit: a hub box with a score or groove behind a flanch which partially closes the end of the box, said score affording room for the washer to play within the flanch, and it

also receives a packing to prevent more effectually, the escape of the lubricating matter, and to exclude the dirt from the box and axle."

89. For an *Improvement in Railroad Car Brakes*; R. M. Evans, Assignor to self and Charles S. Gale, Laconia, New Hampshire.

Claim.—"The arrangement and combination of slots of the brake rod, with the chains and brake levers, in such a manner, that one of each pair of levers will be operated immediately by the brake rod, at the end of its respective slot, while the other lever of each pair will be moved in the other direction, by the action of said chains in whichever direction the ears may be moving."

90. For an *Improvement in Oil Cans*; Thomas Priestly, Assignor to Daniel Holden, Saxonville, Massachusetts.

Claim.—"Combining with the oil vessel, and arranging with respect to the discharging tube thereof, a weight, whereby when said oil vessel is overset, the gravitating power of the weight may move the discharge tube into a position from whence no fluid or oil may escape from it. Also, arranging the air inlet tube, so that its opening into the air vessel and its opening for the reception of air, shall be on opposite sides of the axis of the vessel, or with respect to the weight and oil discharge tube."

91. For an *Improved Apparatus for Heating and Ventilating Buildings*; John Sawyer, Assignor to self and Thomas Hale, Fitchburgh, Mass.

Claim.—"The arrangement of the ventilating chamber, with the main hot air flue, the smoke flue, and air heating chamber, the ventilating chamber and hot air flue having valves applied to them—the whole being capable of being used in heating and ventilating the apartments or stories of a building."

92. For an *Improved Machine for Making Envelopes*; William H. Lowe, Albany, N. York.

Claim.—"1st, The cutting out of the blank by a shearing cut, for the purpose of making a smooth cut. 2d, The position of the knife, to economize the waste of paper. 3d, Drawing the blank through the hole in the face plate, thereby giving to the flap a preliminary fold. 4th, Holding the blank by means of atmospheric pressure, while the folders are operating. 5th, The adjustable blocks. 6th, Drying the gum for the sealing flap, by means of a current of heated air. 7th, Feeding the paper to the knife, by means of the feeding rollers. 8th, The cam movement, in combination with the hollow slide. 9th, The mode of folding the finger."

APRIL 15.

93. For an *Improvement in Power Looms*; Andrew Allen, Wilmington, Delaware.

Claim.—"The combination of the fork on the lifting lever, the stationary hand, and the sliding pin, or its equivalent."

94. For an *Improvement in Calendar Clocks*; Edwin Allen, Glastenburgh, Conn.

Claim.—"The lever with its pin attached to the wheel, and the eccentric applied to the lever, in combination with a spring, for the purpose of controlling the operation of the said lever, in combination with the pins, in all positions of the clock movement."

95. For an *Improved Machine by which Cattle Raise Water for themselves*; J. A. Ayres, Hartford, Conn.

Claim.—"The combination of the bucket with the faucet attached—platform and wheel and axle—the above parts being connected by the ropes or chains."

96. For an *Improvement in Securing and Releasing Blocks of Lasts*; Andrew J. Barnhart, Hartfield, New York.

Claim.—"The fastening or catch, arranged so that the insertion of the lever or last hook, will disengage it, and allow the block to be freely removed."

97. For an *Improvement in Coal Stoves*; W. W. Binney, Seneca Falls, New York.

Claim.—"The partition, placed within the cylinder, and provided with a damper, the vertical tube or pipe, also within the cylinder, and the hollow base, provided with a register."

98. For *Improved Arrangement of Means for Operating Cut-off Valves of Steam Engines*; Henry E. Canfield, City of New York.

Claim.—"The spring cramps as arranged, in relation to the sliding bar of the governor."

99. For an *Improvement in the Arrangement of Grates and Dampers for Chimneys*; Jacob Cohen, City of New York.

Claim.—"The arrangement of the centrally suspended damper, in relation to the grate and the surfaces of escape passage into the chimneys."

100. For an *Improved Stump Extractor*; J. B. Creighton, Tiffin, Ohio.

Claim.—"The combination and arrangement of the vertical screw, the nut and the rollers, with the bearing plate and frame, the lever carrying a wheel, in combination with the frame, so as to expedite and facilitate the transportation of the machine."

101. For an *Improvement in Omnibus Registers*; Levi Cromwell, Baltimore, Md.

Claim.—"The use of the bar, for the double purpose of a stop, by which the operating pawl shall at the end of its thrust be confined within the circle of the ratchet teeth of the wheel, and thus lock it, and of a medium, by which to apply a strong force through the sliding lever or drop leaf, or its equivalent, to the spring of the pawl."

102. For an *Improved Lock Hasp*; M. Newman, 2d, Oak Hill, New York.

Claim.—"The sliding jaw or head, and the hook attached or fitted to the plate or bed, and operated by the lever and rack."

103. For an *Improvement in Churns*; William Newbrough, Mohican, Ohio.

Claim.—"The combination of the oblique bulged rockers with the diagonal separator, for producing a violent agitation of the cream."

104. For an *Improved Wheel Hub*; Joseph Summers, Raleigh Court House, Virginia.

Claim.—"My improved wheel hub, composed of the pipe box, and its radially grooved central flanch, combined with the half hubs, and their radially grooved flanches, and with the embracing band."

105. For a *Preparation of Oil Ground, to receive Photographic Impressions*; Joel H. Tatum, Baltimore, Maryland.

Claim.—"The mode of preparing and rendering oil prepared surfaces impressible or sensitive to the photographic art, by the temporary destruction or chemical change of the oil on the immediate surface, by the use of the spirits of wine and alkaline solution, and then the fixing the impression by the use of hyposulph. soda, and diluted acid, by which last application, the alkalis are neutralized, and the oil restored with the impression permanent upon the surface."

106. For an *Improvement in Vault Covers*; William D. Titus, Brooklyn, N. Y.

Claim.—"The combination of the pivoted cross bar, attached to the under side of the top of the vault, and the spring catches fitted to the stem projecting from the under side of the cover. Also, the employment of the hinged forked drop lever, for the purpose of releasing the spring catches."

107. For an *Improvement in Railroad Brakes*; Benjamin T. Trimmer, Parma, N. Y.

Claim.—"1st, The combination of the secondary brake rods with the tumblers, said tumblers being firmly attached and supported by it. 2d, The combination of the hand wheel and secondary brake rods, said combination performing the double function of braking the wheels of the car to which it is attached, and raising the tumblers to operate the other brakes. 3d, The combination of the rock shaft with the extensible and elastic chain, by which the forward motion of the engine relaxes the brakes, without danger of breaking said chain."

108. For an *Improvement in Electro-magnetic Engines*; Maurice Vergnes, City of New York.

Claim.—"The concurrent action of two or more electro-magnets, parallel and, with contrary adjacent poles, revolving upon an axle common to both, within a double multiplying coil, arranged or running between and on the outside of the magnets, in opposite directions, and acting upon both sides or faces of the magnets."

109. For an *Improvement in Wigs*; DeWitt C. Warner, Wilkesbarre, Penna.

Claim.—"Attaching the hair to a ground work of gutta-percha, by means of the adhesive property of gutta-percha, as developed by the application of heat."

110. For an *Improvement in Stone and Marble Saw*; Henry H. Whitey and Edward A. Gray, East Poultney, Vermont.

Claim.—"The combination of the tubes, wires, organs, keys, or their equivalents, when provided with a rubber covering, or its equivalent."

111. For an *Improved Door Spring*; Gilbert L. Bailey, Portland, Maine.

Claim.—"The spring, crank arm, and rod, operating in connexion."

112. For an *Improvement in Grain Weighing Machines*; William H. Bramble, Cincinnati, Ohio; ante-dated, April 8, 1856.

Claim.—"1st, The double chambered oscillating vessel, when combined with and forming part of an automatic weighing apparatus. 2d, Dividing the vessel into two compartments, by means of a longitudinal flexible partition, when the said vessel is arranged with and forms a part of a weighing apparatus. 3d, The combining gates of different sizes with the conducting chute, and with apparatus that can be operated by the vibration of the scale beam. 4th, The combination of the double gates with each other, and with the ratchet wheels, the retaining click and the detaching movements. 5th, Detaching the click which holds the gate or gates in an open position, through the medium of a vertical tilting lever, combined with the scale beam. 6th, The arrangement of the auxiliary weighing poise and the movable table, when the said table is combined with and operated by the gate."

113. For an *Improvement in Adjusting the Angles in Machines for Sawing Marble Obelisks*; Lebbius Brookes, Great Falls, New Hampshire.

Claim.—"The peculiar combination of mechanism, by which each of the saw frames is moved relatively to the other, and so as to dispose its saws either in or out of parallelism with those of the other, as circumstances may require—the same consisting of the upright rod, the bell crank rod, their slides, staple guides—the same being applied to the main frame and a saw frame. Also, combining with each of the bell crank shafts and the rod, and each of the saw frames, and its suspension rod, the movable frame, whereby said suspension rods are adjusted or moved, at their lower ends and in the same directions."

114. For an *Improved Method of Hanging and Elevating or Depressing Farm Gates*; J. Francis Downing, Erie, Penna.

Claim.—"The part of the hinge and the application of the lever as a means of elevating and lowering the gate, including the manner of obtaining the fulcrum or point of purchase, by attaching a rod to any convenient point on the large post."

115. For an *Improvement in Air Engines*; John Ericsson, City of New York.

Claim.—"What I claim in the engine for producing motive power with heated air is, by means of a piston working within a cylinder, under a mode of operation, performing the successive combined operations of simultaneously discharging the heated air, and taking in the charge of cold air, compressing and transferring it to a regenerator and heater, or either, and thence to the opposite end of the cylinder, to act upon and impel the piston."

116. For an *Improvement in Attaching Thills and Poles to Vehicles*; Abram J. Gibson, Clinton, Massachusetts.

Claim.—"The manner of attaching thills to vehicles, by means of broad iron hinges, independent of each other, without a cross bar."

117. For an *Improvement in the Mode of Protecting Vines*; Abel H. Grennell, Springfield, Vermont.

Claim.—"The so constructing the lattice frames, that they may be swung with the vines upon them, into a compact form, and be protected by closing around them, the double doors, to protect the vines from the weather."

118. For an *Improvement in Frames for Musquito Nets*; Samuel E. Hartwell, City of New York.

Claim.—"The arrangement for securing the ribs rigidly in position when expanded; that is to say, the radial groove or knob, in combination with the grooved clamp."

119. For an *Improvement in Straining Marble Saws*; William B. Hatch, Elmira, N. York.

Claim.—"The rectangular saw frame, constructed with centre bars and tension braces, for straining the saws."

120. For an *Improvement in Manufacture of India-Rubber*; Nathaniel Hayward, Colchester, Connecticut.

Claim.—"The improved process of cementing and uniting one piece of vulcanized rubber with another piece of rubber, either vulcanized, or in a state capable of being vulcanized."

121. For an *Improvement in Machines for Sawing Marble in Obelisk Form*; J. E. Haviland, Galveston, Texas.

Claim.—"Adjusting the saw frame *r*, more or less angularly or obliquely with the saw frame *d*, by means of the adjustable or sliding plates, which are fitted over curved surfaces on the cross pieces of the frame."

122. For an *Improvement in Spreading Rollers for Stretching Cloth*; Jonathan J. Hillard, Fall River, Massachusetts.

Claim.—"As a new and useful improvement on the revolving reciprocating spreader, the jointed and pivoted arrangement of the serrated stretching bars, with the obliquely set wheels, on or round the axis of the spreader, by means of the loose radial spokes and transverse pivots, for connecting the stretching bars with the obliquely set revolving wheels, and whereby increased freedom in the longitudinal play of the bars is obtained, and the cloth thereby more easily and effectually stretched without injury, and without the interposition of lubricating material, when such would be apt to soil the cloth."

123. For an *Improvement in Bedstead Fastenings*; William Hinman, Elkhart, Ind.

Claim.—"Giving an upward inclination to the upper surfaces of the tenons on the side boards and on the head and foot boards, and a corresponding shape to the mortises in the sections of the posts, that receive said tenons, by which the action of the screw connexion between the upper and lower sections of the posts, are enabled to form a close jointed and perfect union between the rails, the head and foot, and the sectional posts."

124. For an *Improvement in Grain and Grass Harvesters*; William H. Hovey, Springfield, Massachusetts.

Claim.—"Providing the front ends of the cutter and sickle bars, with lips or projections—the lip or projection bearing upon ledges on the fingers."

125. For an *Improvement in Candle Cutting Apparatus*; John Jones, Brooklyn, New York.

Claim.—"1st, The concave guiding surface, as a means of gauging the candle's length taken at its axis. 2d, The combination of the sliding box with the cutter, operating for the purpose of cutting candles of equal length, taken at their axis."

126. For an *Improvement in Hay and Cotton Presses*; Simon Ingersoll, Green Point, New York.

Claim.—"Operating the follower by means of the levers attached to swinging frames, and connected to the clamps, for lifting the follower bars, the retaining clamps or their equivalents being employed for sustaining or holding the follower, when the bar are released from the clamps."

127. For an *Improvement in Safety Platforms between Railroad Cars*; James Kline, Jr., and Simon V. Kline, Chicago, Illinois.

Claim.—"The peculiar construction of a connecting safety platform between railroad cars."

128. For an *Improvement in Hoisting Drums*; George W. La Baw, Jersey City, New Jersey.

Claim.—"Constructing the coilers hollow and with a slot in them for the passage of the rope, together with the spring, or equivalent, for the purpose of holding and protecting the surplus rope."

129. For an *Improvement in Fire Arms*; Palmey Lancaster, Burr Oak, Mich.

Claim.—"The operation of the transversely sliding chambered breech, by means of the notches in the breech, and the swinging inclined tooth applied to the trigger."

130. For an *Improvement in Metallic Bedsteads*; Marshall Lefferts, City of N. Y.

Claim.—"The combination of the angle iron side rails, with the corrugated or  formed cross bars and straps."

131. For an *Improvement in Whip Sockets*; William H. Lyman, Newark, N. J.

Claim.—"The application of a piece of sheet india-rubber to the common whip stock, so as to secure the whip to its place, and to prevent dirt, moisture, and other injurious substances from entering the socket, and causing damage to the whip."

132. For an *Improved Stereoscope Case*; William Loyd, Philadelphia, Penna.

Claim.—"The construction of a grooved box, in combination with the stereoscope lenses, to hold a number of pictures, and the adjustment of the focus, by means of placing the picture in one of the grooves, more or less distant from the lenses, according to the eye-sight of the spectator."

133. For an *Improvement in Apparatus for Hoisting Coal*; George Martz, Pottsville, Pennsylvania.

Claim.—"Supporting the hoisting carriage upon outer and inner sets of wheels, arranged in such a manner, in relation with the double sets of railway tracks, and the discharging chute, that the coal car in said hoisting carriage, is made to self-discharge its load of coal into said chute. Also, so proportioning and arranging the respective parts of the hoisting carriage and the coal car, that as soon as the elevating power is detached from said carriage, it will, by the force of the gravity, run back to the bottom of the slope track, and re-station itself in the proper position for discharging its empty coal car and receiving a loaded car."

134. For a *Double-acting Catch for Reversible Backs of Settees*; B. F. M'Creary, City of New York.

Claim.—"The turning catch plate, made to tilt either way, by a weighted arm, and having two catches, so applied as to form a catch for the back on one side only of the seat, in one of the tilted positions of the catch plate, and on the other side only of the seat in the other tilted position of the catch plate."

135. For an *Improved Implement for Reaping Rice*; W. J. M'Intosh, Savannah, Ga.

Claim.—"The cutters, in combination with the wire, and the cradle and slides."

136. For an *Improved Apparatus for Feeding Furnaces with Fuel*; Alexander M. Sprague, Mobile, Alabama.

Claim.—"The furnace-feeding apparatus composed of a cylinder, or box or other form, sliding through an opening in the furnace front, having its inner end closed, and an opening in the bottom being fitted with a door at its outer end, and with a piston and sliding shutter."

137. For an *Improved Diaphragm Water Metre*; R. L. Hawes, Worcester, Mass.

Claim.—"The elastic diaphragm, so constructed and arranged as to operate without attachments to the moving parts, and without being subjected to strain."

138. For an *Improvement in Electric Telegraph*; Charles Kirchhof, City of N. Y.

Claim.—"1st, The prevention of the too early intermission or restoration of the circuit, in the use of self-intermission through the method by which a key shuttle, or its equivalent, is not only stationary during the whole travel of the armature, but also for a certain time afterwards, so that the circuit, during that time, remains either permanently broken or closed, but afterwards this shuttle is started and shoved by the indirect influence of the motion of the armature, through some devices, till to the moment of breaking or restoring the circuit and here stopped, and the armature, and by that, all oscillating mechanical parts are obliged to reverse immediately. 2d, The manner of stopping the index of all instruments of a circuit right opposite the desired letter, without disturbing or preventing the index armature or shuttle on any instrument, to complete their adopted motion, by means of a 'watcher' and 'waker,' operated by the revolving hook and key lever, or its equivalent, so that the watcher will keep open; meanwhile the shuttle makes contact, whereby the indices stop until the key is relieved, and the watcher closes again. 3d, The method to keep all instruments of a circuit in unison, working and without any mechanical means through employment of 'the induction current,' by retarding the influence of the electro-magnetic power at a certain degree upon that instrument which intermits the circuit, not having their intermitters in activity, are governed by it and

insured to complete their motion before the circuit of the prime current is intermitted or restored again. The said induction current, in each instrument, being used in connexion with some suitable means for connecting and disconnecting the self-intermitter with the armature lever, and also with a means for closing and opening the induction circuit, and for the opening and closing of the accommodation course of the prime current, which act together, at once answering simultaneously their different purposes."

139. For an *Improvement in Harvester Raking Attachments*; William H. Hovey Springfield, Mass.

Claim.—"1st, 'The swinging rake, in combination with the reciprocating rake, when said rakes are used in combination with the device for operating the rake, formed, viz : of the catch lever with pin attached arms, and the bar attached to the rake, whereby the proper movements are given at the desired time to the rake. 2d, Operating the reciprocating rake, by means of the chains attached to said rake, and passing around pulleys and attached to the pulleys, which pulleys are turned or operated alternately by the wheel having teeth upon its outer and inner peripheries."

140. For an *Improvement in Grain and Grass Harvesters*; William A. Kirby, Buffalo, New York.

Claim.—"The manner of attaching fingers, as constructed with semi-circular recesses, whereby they are secured to the angle iron finger bar by bolts, without reducing the strength of bar of the finger while the bolts themselves, serve the double purpose of securing the fingers, and as guides to the cutter bar. Also, the use of the rivets, when projecting above and below the cutters, and used with the interspace and recesses of the fingers."

141. For an *Improvement in Repairing Railroad Bars*; James M'Lellan, Detroit, Michigan.

Claim.—"Placing the rail or bar to be heated within a cooler, which is fitted within the furnace, and supplied with water from a reservoir at the outer side of the furnace—the cooler being so formed or arranged, as to encompass or be in contact with the parts of the rail bar not designed to be heated."

142. For an *Improvement in making Brass Kettles*; O. W. Minard, Waterbury, Connecticut.

Claim.—"The employment of the clamps or holder, in combination with the working rollers, for drawing or working, for the purpose of forming a disk of metal into a kettle, without employing a mould or former therefor. Also, the combination of a centre-piece, for holding the disk of metal and disk, by which the bottom of the article being manufactured is formed, by the combined action of the disk, and drawing or working apparatus."

143. For an *Improved Machine for Folding Paper*; John North, Middletown, Conn.

Claim.—"1st, Folding paper by means of a stationary straight edge or knife and folding nippers. 2d, The manner of relieving the sheet from the nippers. 3d, The adjustable check, and the mode of releasing its hold, by the advance of the nippers. 4th, The rotating trip dog, for raising and depressing the fingers. 5th, Attaching the knives to the reciprocating carriage. 6th, Operating the reciprocating carriage, by means of the crank, the slotted connecting rod, the lever, and the link, whereby I attain accuracy and ease of movement. 7th, The cutting rollers hung on a bar, vibrated and checked. 8th, The arrangement of the T levers, with the double concentric rock shafts, for operating the nippers by one cam."

144. For an *Improved Machine for Raising and Creasing Leather Straps, &c.*; Geo. W. Pruyne, Mexico, New York.

Claim.—"In combination with the grooved rolls, one of which is yielding, the guides through which the creased part of the strap is drawn, and so that said guides shall serve to direct the finished strap, as it passes between the rolls."

145. For an *Improvement in Cut-offs for Steam Engines*; John S. Shapter, City of New York.

Claim.—"Holding up the poppet steam valvo of a steam engine, by the fluid contained in a supporting chamber, and adjusting the discharge of said fluid from said chamber, for the purpose of dropping said steam valves, and cutting off the supply of steam to the cylinder, at different points, as may be required."

146. For *Improved Head and Tail-blocks for Saw Mills*; E. H. Stearns, Cincinnati, Ohio.

Claim.—"1st, The eccentrics, one, two, four, more or less, or their equivalents, in combination with the setting arms and ratchet racks, or their equivalents, for the purpose of moving and setting the log laterally to the saw. 2d, The combination of two or more pieces, composing the sliding dogs, passing through one or more openings on the same side of the saw, so near each other, that they may be driven in or out of the log, by the same blows of the mill bar—the ends of these dogs being so beveled or chamfered, as to cause them to bind and tighten themselves in the openings through which they pass—which dogs may be made in separate parts, or jointed partially to their heads, but not so close or firm as to prevent the parts from binding in their openings when driven into the log. 3d, The combination of the levers and recess, made in the under part of the sliding head in the foot block, and operated by the motion given to the sliding head, which combination forms an extra safety trip, for stopping the saw carriage when the dogs come opposite the saw, to prevent the saw from striking the dogs, which are operated by the motion given to the sliding head."

147. For an *Improved Puddle Ball Squeezer*; Shubael Wilder, New Castle, Penna.

Claim.—"The employment of the circular flanch, constructed in sections, the same being connected by beveled dove-tailed joints."

148. For an *Improvement in Weighing Scales*; R. F. Wolcott, Claremont, N. H.

Claim.—"The arrangement of the compound weighing poise with the screw, and with the sides of the scale beam, in such a manner, that the said poise may be either lifted from place to place upon the beam, or be moved gradually thereupon, by turning the said screw."

149. For an *Improvement in Seeding Machines*; Thomas A. Risher, Assignor to self and J. R. Cooper, Lancaster, Ohio.

Claim.—"Bars and plates, in combination with the reciprocating slides, and the double holed bottom."

150. For an *Improved Awl Haft*; Benjamin James, Assignor to Roswell E. James, Worcester, Massachusetts.

Claim.—"Improved mode of constructing an awl haft, viz: of two levers crossing one another, turning on a common fulcrum, and provided not only with jaws like a pair of fingers, but with a chamber in one or both of the handle arms of said levers. Also, forming the rear end or part of one of the levers with an extension, and so as to lap over the end of the other lever, and receive an entire hammer head upon it."

151. For an *Improved Method of Adjusting Circular Saws for Concave or Convex Work*; James M. Kern, Assignor to Enoch P. Fitch and Isaac Scott, Morgantown, Virginia.

Claim.—"The arranging a circular saw with its followers upon a shaft, so that said saw may be converted from a disk to a concave saw, or vice versa, without removing any of the parts from the shaft."

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152. For an *Improved Fishing Tackle*; Julio T. Buel, White Hall, New York.

Claim.—"1st, A hook with two barbs. 2d, Making the hook having two barbs in two parts, and uniting said parts loosely together, so that one shall turn free of the other. 3d, Combining with the barb, one or more minnow barbs, and having one of the barbs turn free of the barb."

153. For an *Improvement in Seeding Machines*; George A. Bitler, Lancaster, Ohio.

Claim.—"The reciprocating slide having different sized holes made through it, in combination with the adjustable bottom and adjustable plates; said slide being also arranged in combination with and operated by the pulley."

154. For an *Improved Machine for Sowing Fertilizers*; Warren S. Bartle, Newark, N. Jersey.

Claim.—"The distributors, composed of the radials, in combination with the shaft and fender."

155. For an *Improvement in Balance and Slide Valve for Steam Engines*; Alexander Buchanan, City of New York.

Claim.—"The means of maintaining the differential pressures on the two sides of the valve, necessary for balancing the same, that is to say, the combination of an apparatus with the valve."

156. For an *Improvement in Brick Machines*; Patrick S. Devlan, Reading, Penna.

Claim.—"In combination with a stationary mould and a reciprocating piston or plunger, an intermittently rotating, feeding, and conveying apparatus, through which the plunger passes, to compress the clay, and form the brick, and which remains to receive the brick as if ejected from the mould, and carries it forward and out of the way of the succeeding clay box."

157. For an *Improvement in Cultivators*; George Esterly, Heart Prairie, Wis.

Claim.—"The hanging of two or more ploughs to a supporting beam or axle, by swiveling joints at each of the ends of their drag bars, so that said ploughs may be moved either way laterally, without affecting the axle, and still maintain their parallelism; and this I claim, whether the stock to which the ploughs are connected be adjustable in the drag bars, or the ploughs be adjusted in the stock or otherwise."

158. For an *Improved Machine for Digging Peat*; Abraham Fitts, Worcester, Mass.

Claim.—"1st, The movable knife or fork. 2d, The digger, consisting of two or more blades, in combination with a movable knife or fork, to cut the third side or sides. 3d, The combination of the digger, the crane, and the platform, or ears, to hold them and receive the peat."

159. For an *Improvement in Revolving Fire Arms*; Gustav A. Blittkowski and Frederick W. Hoffman, City of New York.

Claim.—"1st, Effecting the ramming of the cartridge by means of the fixed rammer, in combination with the reciprocating breech chamber. 2d, The arrangement for folding and releasing the cartridges—consisting of the clamp spring, the knob upon the axis of the breech chamber, and the magazine for containing a supply of cartridges. 3d, Effecting the several motions required for operating the rotating breech, by means of an axis rigidly connected thereto, and operated from one of the ends of the said axis. 4th, The combination of the slide with the axis of the breech chamber, with the locking bolt, and with the tumbler."

160. For an *Improvement in Receiving Magnets for Telegraphs*; Andrew Coleman, Perth Amboy, New Jersey.

Claim.—"So constructing or applying the armature, and applying the spring, or its equivalent, that the armature constitutes the whole or part of a variable lever, which causes the effective force of the spring to increase or diminish, as the magnetic force becomes greater or less, when this is combined with the so applying the finger, by which the local circuit is opened and closed, that the said finger is caused to move with the armature, by friction only, or its equivalent, and after having moved the slight distance necessary to open or close the circuit, leaves the armature free to move as far as necessary, independently of it, thereby obviating the necessity of manual adjustment of the armature, to compensate for variations of magnetic force."

161. For an *Improved Waste Device for Hydrants*; John Culver, Baltimore, Md.

Claim.—"The arrangement of the plunger relative to the discharge pipe, and capable of elevation proportional to the capacity of said pipe, for forming a chamber in the lower portion of the hydrant, for the reception of the contents of the discharge pipe."

162. For an *Improvement in Door Locks*; John B. Erb, Strasburg, Penna.

Claim.—"The devices of the knob, oval slot, and semi-circular slide, as they operate upon the bolt, all in combination."

163. For an *Improvement in Sugar Evaporators*; Samuel H. Gilman, New Orleans, Louisiana.

Claim.—"1st, The table bottom forming the steam chamber below, and the condensed water chamber above, in connexion with the steam pipes, open at both ends and fixed into the division plate, and, with the evaporating pipes, closed at the top and open at the bottom, and fixed with the tube plate. 2d, The compensating condensed water syphon-pipe, with one leg starting from the reservoir in the steam chamber, and passing

up through the division and the tube plate into the pan, to about one-half of the height of the evaporating pipes, then turning down through the tube plate, and in the same vertical plane with, and terminating in and near the lower end of the condensed water pipe of the condensed water chamber."

164. For a *Machine for Driving Spokes*; Christian Haas and John C. Noll, Chicago, Illinois.

Claim.—"The adjustable hub-bed and spoke guide, in combination with the driving apparatus."

165. For an *Improvement in Hotel Annunciators*; William H. Hale, Worcester, Massachusetts.

Claim.—"The combination of the number plate with a hammer, whereby I am enabled to show the number and strike the bell with the same piece. Also, the arrangement of said tilting number plates, or number hammer, or their equivalents, in ranks upon ranks of wires respectively operating them, the wire passing through slots in the hammer levers."

166. For an *Improvement in the Arrangement of Dampers of Cooking Stoves*; Wm. E. Hayes, Geneva, New York.

Claim.—"The damper connected and operated by the lever and damper rod."

167. For an *Improvement in Steam Boilers*; C. B. Hoard, Watertown, New York.

Claim.—"Closing the openings or man holes, in one or both heads of boilers, by the insertion of a flue, which may be conveniently removed and replaced."

168. For an *Improvement in Preparing Phosphoric Acid as a Substitute for other Solid Acids*; Eben N. Horsford, Cambridge, Massachusetts.

Claim.—"Pulverulent phosphoric acid, for neutralizing alkaline bases, and producing carbonic acid at will, from a mixture of this pulverulent acid with alkaline carbonates, upon the addition of moisture, or heat, or both."

169. For an *Improvement in Suspending Extra Top-sail Yards*; George Hubbard, Stonington, Connecticut.

Claim.—"Arranging the same, or its connexion with the mast, above the cap of the lower mast, and applying said extra yard to the topmast, and suspending it from or near the trestle-tree, whereby said yard may not only be raised up towards said trestle-tree, but be supported, and be capable of being braced around, as occasion may require; and this, without danger of injury to the cap of the lower mast head."

170. For an *Improvement in Flasks for Moulding*; James J. Johnson, Alleghany, Pennsylvania.

Claim.—"The employment of the table, follow board, and plate, the whole, when adjusted by the vertical movement in guides."

171. For an *Improvement in Electro-Magnetic Telegraphs*; Albert J. Partridge, Southbridge, Massachusetts.

Claim.—"The method of operating the circuit hanger, to change the circuit, by means of the clutch and fly wheel, attached to the loose part thereof."

172. For an *Improvement in Coal Breakers*; Thomas Petherick, Pottsville, Penna.

Claim.—"The mode of breaking coal, by causing it to fall from a suitable height, and between proper guards or guides, upon sharp pointed teeth and chisels placed on blocks."

173. For an *Electro-Magnetic Grain Scale*; Nathan M. Phillips, City of New York.

Claim.—"The application of an electro-magnet, to open and close the valve of a scale for weighing grain, by making a connexion between the positive and negative poles of a galvanic battery, by means of the tilting or raising of the beam."

174. For an *Improved Measuring Faucet*; Edwin A. Palmer, Clayville, New York.

Claim.—"The perforated piston in combination with the valve and knob."

175. For an *Improved Apparatus for Raising and Lowering Carriage Tops*; Alanson Quigley, Sheldrake, New York.

Claim.—"The box, cog lever, pawl, and cog wheel, in combination."

176. For an *Improvement in Cast Iron Pavements*; Asa P. Robinson, City of New York.

Claim.—"The cylindrical form with the tangential flat surfaces raised upon its circumference, for contact between the blocks. Also, the peculiar manner of keying the blocks together, and of keeping the blocks to the rails, to prevent vertical motion, and to admit of any one block or rail, or any number of blocks or rails, being moved without disturbing others not required to be moved, by means of the triangular formed spaces, the rebates and the keys, or by means of the projecting surfaces of the blocks and the flanches or lugs on the rails and the key."

177. For an *Improvement in Gas Burners*; William F. Shaw, Boston, Mass.

Claim.—"The interposition of an imperfectly conducting body between the tip and base of gas burners, for the purpose of preventing the conduction of heat away from the point where the gas is burned."

178. For an *Improvement in Working Sheet Metal*; Samuel R. Shepard and Orson W. Stow, Plantsville, Connecticut.

Claim.—"The adjustable rotating guide, attached to either of the rollers."

179. For an *Improvement in Rings for Preventing Nocturnal Emissions*; L. D. Sibley, Northampton, Mass.

Claim.—"The combination of an elastic strip or strips, with an internally toothed ring, in such a manner, that the strip or strips shall serve as a protection against the teeth, until the distension of the penis takes place, when it or they will yield to said distension, and allow the teeth of the ring to act. Also, forming the notches in the edge of the slide, in combination with the spring catch."

180. For an *Improved Conical Tent*; H. H. Sibley, United States Army.

Claim.—"1st, So constructing the tripod, or its equivalent device attached to a single pole, as to admit of easily building a fire. 2d, So constructing a tent with its hood or cowl, in combination with the door and half door or opening, to effect ventilation and the escape of smoke."

181. For an *Improvement in the Method of Fastening Lamps to Lanterns*; Emile Sirret and William H. Scott, Buffalo, New York.

Claim.—"Constructing the lamp with the bottom extending so as to form an annular flanch, which may be revolved with the lamp, independently of the base of the lantern, for the purpose of attaching the lamp to the lantern."

182. For an *Improvement in Projectiles for Fire Arms*; Thomas Smith, Pittsburgh, Pennsylvania.

Claim.—"The construction of balls, or projectiles, for smooth bore or rifle bore fire arms with a spiral cavity, more or less funnel shaped, passing longitudinally through them, for the purpose of giving them a spinning motion, on their long axis, in their passage through the air."

183. For an *Improvement in Pressure Regulating Apparatus for Steam Heating Boilers*; George S. G. Spence, Boston, Mass.

Claim.—"The peculiar arrangement of the steam generator or boiler, the stand pipe, the condensing apparatus, (composed of the receiver, the cover, and the refrigerating vessel,) the safety valve and its pipe."

184. For an *Improved Weather Strip and Lock for Windows, &c.*; Alfred Spear, Passaic, New Jersey.

Claim.—"The combination and arrangement of the devices for operating a weather strip or strips, to effect the double purpose of a weather guard and lock, at the same time."

185. For an *Improvement in Cotton Cleaners*; James H. Kinyon and James Hollingsworth, Chicago, Illinois.

Claim.—"The so arranging of the hopper, feed rolls and brushes, as that they shall draw in the material, divide it into nearly equal parts, and throw one-half in one direction, and remaining half in a contrary direction, to be acted upon by other rolls and brushes."

186. For an *Improvement in Sub-soil Ploughs*; Pells Manny, Waddam's Grove, Ill.

Claim.—"The combination of the circular rotating cutter, separating ring, mould board, and bar."

187. For an *Improvement in Hydro-carbon Vapor Lamps*; Alonzo M. Mace, Springfield, Massachusetts.

Claim.—"The particular arrangement of the bottom of the retort and the jet holes, with respect to the wick tube, whereby the inflamed jets of vapor issuing from the jet holes, are driven downward against the wick tube, and their currents of heat made to ascend against the concave bottom of the retort—the same serving to greatly facilitate the generation of vapor, as well as the heating of the same. Also, combining with the retort, the bell-shaped cap or heel retainer, made of transparent or other proper material."

188. For an *Improvement in Machines for Sawing Marble in Obelisk Form*; James Miller, Buffalo, New York.

Claim.—"The combination of the crank shaft, mounted above the saw frame; the loosely jointed pitman, and the rocking bars, vibrating on fulcrum upon the adjustable frames which guide the saws."

189. For an *Improvement in Corn Harvesters*; R. C. Mauck, Conrad's Store, Va., and W. T. McGahey, McGaheysville, Virginia.

Claim.—"1st, The rotary arms, in combination with the packing guides, for effecting the filling of the body. 2d, The employment of a double series of cutters, for cutting the stalk and stump, and thereby admitting the delivery of the cut product without elevation."

190. For an *Improvement in Corn Shellers*; A. H. Stevens, Warsaw, New York.

Claim.—"In combination with the shelling surfaces, the wings, openings, and spiral flanges or ribs, for the purpose of creating and driving through the machine, a blast or current of air, for separating the grain from the impurities."

191. For an *Improvement in divided Axles for Railroad Cars*; Richard Vose, City of New York.

Claim.—"The connecting segments, when combined with the inner ends of a divided axle, and the embracing tube."

192. For an *Improvement in Coffee Pots*; Charles B. Waite and Joseph W. Senar, Fredericksburgh, Virginia.

Claim.—"The arrangement, whereby the steam from the boiler is discharged into the water in the condenser, which absorbs the aroma, in combination for returning the contents of the condenser into the boiler."

193. For an *Improvement in Link Gearing for Horse-powers*; Thomas D. Burk, Assignor to J. C. Miller and C. A. Fowler, Chicago, Illinois.

Claim.—"The mode of converting the motion of an axis rolling around a centre, into an alternating motion, at right angles to the plane described by the rolling axle, by means of the combination of the crank, connecting link, universal joint, and swiveling bolt of the same."

194. For an *Improved Device to allow for Contraction and Expansion in Wire Fences*; Thomas D. Burk, Chicago, Assignor to James Garrett, Ogle County, Illinois.

Claim.—"The application of the key, the lever, the weight, and the stay, to a wire fence."

195. For an *Improved Auger*; Kelsey Curtis, Assignor to the Winsted Auger Company, Winchester, Connecticut.

Claim.—"The making of an extension bar, connecting the small screw on the end of the auger or bit, with the lips or cutters of the auger proper."

196. For an *Improvement in Completing the Throw of the Valves of Direct Acting Engines by the Exhaust Steam*; Henry R. Worthington, Brooklyn, N. York.

Claim.—"Completing the throw of steam valves of direct acting engines, by the steam already within the cylinder on its way to the open air, or to a condenser."

197. For an *Improved Hoop Machine*; George W. Holmes, Buckfield, Maine, Assignor to Jarvis C. Marble, Paris, Maine.

Claim.—"The arrangement and combination of the pressure rollers, the saw and the stand guard, so as to operate together—the said rollers being pressed towards the saw, with variable degrees of pressure. Also, under that arrangement of the saw and pressure rollers, I claim making the saw dishing, or concavo-convex, by which advantages are gained."

198. For *Combined Shovel and Tongs*; Samuel Huffman, Assignor to self and J. D. Brown, Richmond, Virginia.

Claim.—"The flanch and the plate, when combined with a pair of tongs, for the purpose of forming an instrument capable of being used either as a shovel or tongs."

199. For an *Improved Machine for Tunneling and Quarrying*; Ira Merrill, Assignor to self and Arthur Maxwell, Shelburne Falls, Mass.

Claim.—"The arrangement of the proportionate levers."

200. For an *Improvement in Studs for Wearing Apparel*; Lucius Paige, Cavendish, Vermont, Assignor to self and Albert L. Lincoln, Boston, Mass.

Claim.—"Constructing the back disk holder of an ordinary shirt stud or button, with the slit extending from its circumference to the shank, and having one of its edges raised with respect to the other."

201. For an *Improvement in Looms for Weaving Bags*; Samuel P. Thomas, Lawrence, Massachusetts.

Claim.—"In combination with the compound cam, the endless chain or belt, and the mechanism for moving the switch—the whole being arranged for the purpose of determining the length of the sides, or where to form the bottom of the bags. Also, the arrangement by which uniform tension of the warps is secured, during the movements of the harnesses, or in other words, combining with the breast roller or beam, mechanism by which the breast roller or beam may be moved with respect to the lay, or harnesses, and during the movements of the latter."

MECHANICS, PHYSICS, AND CHEMISTRY.

For the Journal of the Franklin Institute.

Notes on the "Ignition Gas Engine." By T. D. STETSON, Mech. Eng.

A large engine, working by the direct explosive force of carburetted hydrogen, was exhibited in the New York Crystal Palace, during the Fair of the American Institute, last Autumn, and at this date remains in the building. By means of a valve, controlled by the operator, the gas was mingled with pretty nearly its combining equivalents of atmospheric air, and exploded in the cylinder; but unlike gunpowder, which, in burning, changes to gas of a permanently greater volume, the combustion of this already rarified mixture produces a mixture of carbonic acid gas, nitrogen, and water, a change which would increase its mean density except for the high temperature momentarily evolved. The absolute degree of heat developed by the combustion of such mixtures has never been definitely established, but at any estimate between the extremes of 1000° and 5000° Fah., it is sufficient to induce a very considerable increase of pressure. This increase alone is in this engine relied on to impel the piston, and as considerable money has been expended on this device, and some attention has been attracted to it abroad, a few notes of its performance may be placed on record as possessing a negative, if not a positive value.

The inventor and exhibitor of this now neglected machine is Dr. Alfred Drake, of Philadelphia. The diameter of the cylinder is 16 inches, the position horizontal, and the stroke of piston 18 inches. One part of gas is mixed with as nearly as possible 9 parts of air, and the mixture is drawn in at the ordinary atmospheric pressure until about one-third of the stroke is performed. The valve is then allowed to close, and the piston continuing on, immediately uncovers a small recess in the side of the cylinder and allows the mixture to come in contact with a mass of metal at an incandescent heat. An explosion sufficient to produce a sensible concussion follows after the lapse of a very short interval. As may be readily seen, the action of this motor is very changeable in its intensity. How great a pressure is obtained at the moment of the explosion, has never been tested by the indicator or otherwise; but theory would indicate an absolute pressure of from 20 to 100 lbs., according as the high or low estimates of temperature be assumed. Whatever the actual maximum heat of the gas, it is evident that it is rapidly diminished by the presence of the metallic surroundings, and the mean pressure may be inferred from the fact that when worked single-acting, it is capable of making about 60 revolutions per minute without load.

These data refer to an exhibition made for the especial observation of the writer, as mechanical reporter for the *Tribune*, and being subject to frequent pauses, the experiment extended over a period of two hours. No brake or other resistance was applied, nor was the engine worked otherwise than single-acting; the valves at one end of the cylinder being allowed to remain at all times open to the atmosphere.

Although the engine is, as may be inferred, intended to be of sufficient power for practical use, and although it was for a long period in daily exhibition in the same locality, the facilities offered for accurate observation of its results have been extremely limited. The gas employed was from the street mains, the same as used for illumination, and no means were available for measuring the quantity consumed during any given short period. The pressure of the mixture until the closing of the induction valve may be assumed at a very little below the atmospheric, but during the short period intervening between the close of that valve and the explosion, the pressure may be supposed to diminish according to pretty nearly the same law as that of steam. How much should be allowed for the effect of the heat previously contained in the metal? It is probable that the fluid as it flows in through a warm passage, and extends itself upon the interior of the cylinder, becomes heated nearly to the temperature of the latter, or sufficiently to produce a very sensible rarification. Whether or not this may be held to be of any sensible importance, it is evident that the amount of gas in the cylinder at the period of the explosion, is too inconsiderable to produce the fullest effects possible to realize from such a device.

The method of igniting is one of the principal novel features of the engine, as might be inferred from its name. In previous attempts to work by the direct expansive force of exploding gases, this point has been considered the chief difficulty. An electric spark has been found impracticable; a jet of gas would of course be extinguished at each explosion; and the only available match which seems to remain, is an intensely heated solid.

Metal, at a sufficiently bright white heat will ignite gas, and the next remaining questions are,—what metal to employ, where to dispose it, and how to maintain its extraordinary temperature? The mode of igniting adopted by Dr. Drake, in the engine now considered, is to insert a hollow cup of thin cast iron, and direct into the cavity a constant blow-pipe flame from the outside. The iron is said to retain its integrity several hours, and often days in this situation, a period considerably longer than platinum will endure when heated in contact with this kind of gas. The rapid destruction of platinum when exposed to this agent at a high temperature, is a fact pretty generally known, and which has been confirmed by every effort yet made to employ the metal in this engine. The feeble performance described above, might probably be much improved by the addition of a compressing pump, which would supply the mixture at a pressure of some 40 or 50 lbs. per square inch. Thus condensed, the force, at the moment of combustion, would rise to as great an amount as could well be availed of.

The high temperature of the contained fluid must of course convey to the metal a great quantity of heat, and to prevent an injurious accumulation, the cylinder is surrounded by a water jacket. Means are also provided for circulating water through the piston, by making the piston-rod hollow, and connecting thereto a flexible tube. This apparatus was not employed on the occasion referred to, and whether or not these precautions are necessary in practice could not be judged from the short periods during which the engine was allowed to work, which rarely exceeded ten or fifteen consecutive minutes.

Taking a general view of the actual performance, the engine although failing to work either quietly or efficiently, gives indications that it is possible to impel machinery by this method with a degree of economy exceeding that of steam. I have not calculated the theoretical saving, and it would be of little importance to do so, as it is evident that but a small fraction has yet been utilized. The inventor avers that any hydro-carbon may be employed in the same manner by mixing the vapor with the atmosphere, and he hopes yet to see locomotives crossing the arid plains and barren passes of the Rocky Mountains impelled by a few barrels of camphene alone. Unpromising as the above results may appear, there is little to indicate that it cannot be done.

In one vitally important respect Drake's gas engine differs from those employing aqueous vapor, *i. e.*, the temperature of the cylinders. Steam engines consume and dissipate heat; this, on the contrary, generates it to a degree supposed to be inconveniently great. A steam cylinder cools and loses its efficacy unless protected by jackets or lagging; this burns itself up, unless water is applied to cool it. When some master spirit shall combine them so that the surplus of heat in one shall give vitality and vigor to the other, a great step will have been taken towards utilizing the full mechanical equivalent of heat. As the invention now stands, it cannot be very highly recommended. The power is violent, vacillating, noisy, and of unascertained economy. The igniters are liable to crack, and are sure to undergo such a chemical change as to be destroyed in a very short period. The absence of a boiler tends very much to its advantage in point of lightness as compared with steam power, and

the necessity for a large balance wheel to soften the shocks and to impel the work during the comparatively long periods while the engine is powerless, might be avoided by connecting two, three, or more engines to the same shaft. But the power has yet to establish its claims to efficiency, nothing having as yet transpired to absolutely prove it practically capable of impelling any machinery except its own necessary apparatus.

New York, May 9th, 1856.

For the Journal of the Franklin Institute.

Particulars of the United States Mail Steamer Adriatic.

Hull built by James and George Steers, New York. Machinery by Novelty Iron Works, New York. Intended service, New York to Liverpool.

HULL.—

Length on deck from fore part of stem to after part of stern-post above the spar deck, ...	351 feet. 8 inches.
Length on load line, ...	343 " 10 "
Breadth of beam at midship section, (<i>moulded</i>),	48 " 8 "
" " " "	50 "
Depth of hold	25 "
" " to spar deck, ...	33 " 2 "

Floor timber at throats, *moulded* 22, *sided* 13 to 16.

Frames, distance apart at centres, 33 to 36; strapped with diagonal and double laid iron straps, 5 by $\frac{7}{8}$ inches.

Draft of water at load line,	20 feet.
Launching draft,	10 " 2 inches.
Area of immersed midship section at this draft,	880 sq. feet.

Displacement at 20 feet draft, 5233 tons; average displacement per inch from light load line of 17 feet 1½ inches; 26 7-16 tons, and from light load line to load line of 20 feet, 28¾ tons.

Masts and rig—Brig.

ENGINES.—Two—Inclined oscillators.

Diameter of cylinder,	.	.	100 inches.
Length of stroke,	.	.	12 feet.
Weight of engines,			
“ boilers, water, spars, &c., &c..	}	2200.	
“ hull,	}	2040.	

Boilers.—Eight—Vertical Tubular.

Length of boilers,	two 17 feet, and six	20 feet.	3 inches.
Breadth " each,		13 "	
Height " exclusive of steam chimney,		14 "	
Number of furnaces,	48.		
Breadth of furnaces,	.	2 "	9 "
Length of grate bars,	.	7 "	6 "
Number of tubes,	13,504.		
External diameter of tubes,	.		2 "
Length of tubes,	.	3 "	2 "
Diameter of smoke pipes,	each	8 feet.	
Height " " above deck,	.	48 "	
Description of coal,	Anthracite or Bituminous.		
Draft,	Natural.		

PADDLE WHEELS.—

Diameter, ...	40 feet.
Length of blades, ...	12 "
Depth "	24 inches.
Number "	32. C. H. H.

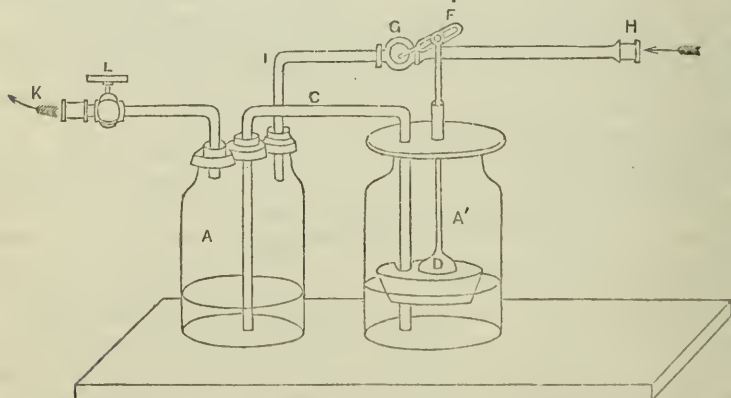
*Markus's Apparatus for Regulating the Pressure of Gas used in Chemical Laboratories.** By FERDINAND F. MAYER.

The application of gas in laboratories, which besides its comparative cheapness offers advantages not attainable by any other fuel, is, however, combined with some trouble when a certain temperature is required to be kept up for a greater length of time. This obstacle is caused by the different amount of pressure on the gasometers at various hours of the day and night, it being considerably lighter during the former than during the latter period.

The following table shows these variations as observed during a few days in May last, by Prof. E. Hornig in Vienna:

Date.	Hour.	Pressure in inch. Water.	Date.	Hour.	Pressure in inch. Water.	Date.	Hour.	Pressure in inch. Water.	Date.	Hour.	Pressure in inch. Water.
May 4,	10 A. M.	$\frac{1}{2}$	May 5,	1 $\frac{1}{2}$ P. M.	$\frac{3}{8}$	May 5,	6 P. M.	$1\frac{1}{2}$	May 6,	NOON.	$\frac{1}{2}$
"	1 $\frac{1}{2}$ P. M.	$\frac{1}{8}$	"	3 $\frac{1}{4}$ "	$\frac{3}{8}$	"	6 $\frac{1}{4}$ "	$1\frac{1}{4}$	"	1 $\frac{1}{2}$ P. M.	$\frac{1}{4}$
"	5 $\frac{1}{4}$ "	$\frac{5}{8}$	"	4 $\frac{1}{4}$ "	1	"	6 $\frac{3}{4}$ "	2	"	7, 8 A. M.	$\frac{1}{8}$
"	6 "	3	"	4 $\frac{1}{2}$ "	$\frac{1}{2}$	"	6, 9 A. M.	$\frac{1}{2}$	"	11 "	$\frac{1}{4}$
"	6 $\frac{1}{2}$ "	2	"	5 $\frac{1}{2}$ "	$1\frac{1}{2}$	"	9 $\frac{1}{4}$ "	$\frac{3}{8}$	"	1 $\frac{1}{4}$ P. M.	$\frac{3}{8}$
"	5, NOON.	$\frac{1}{2}$	"	5 $\frac{3}{4}$ P. M.	1	"	9 $\frac{1}{2}$ A. M.	$\frac{1}{2}$	"	5 "	$\frac{3}{4}$

To counteract this irregularity, Mr. S. Markus, the machinist of the Imperial Institute, on the suggestion of Prof. v. Hauer, contrived a very simple apparatus which, at least, for temperatures not exceeding 100° C., (212° F.) has been found to work admirably.



A and A' in the annexed cuts, represent two glass vessels filled to one-third with water, and partially sunk into the board or plate upon which they are placed. A is a common Wolfe's flask with three corks fitting air-tight, each holding a glass tube. A' is a wide mouthed jar covered with a plate of metal, which is secured to the neck by a few corks fastened to the lower side, without being air-tight.

The two vessels are connected by the glass tube c, which passes at both ends vertically nearly to the bottom, and by being filled with water, causes the liquid in the two bottles to be of the same level. D is

*From the Journal of the Imperial Geological Institute at Vienna, 1855.

a cork float of conical shape. To its centre is fastened a metallic rod, which at *F*, connects with a lever having a slitted axis, which allows the rod to retain its vertical position when the lever is being moved upwards and downwards. By these movements, the lever opens or closes the stop-cock *G*, in the caoutchouc pipe *HI*, which receives the influx of gas at *H*. When the lever *GF* is parallel with *HI*, the stop-cock *G* is fully opened.

The inside bore of the cock is oval and of the same size as that of *HI*. At *K*, the apparatus is connected with another caoutchouc pipe; the stop-cock *L*, or a clamp serving to regulate the efflux of gas at the burner, that is, the size of the flame. The bore of the connexion at *K* is somewhat smaller than that at *HI*.

The manner in which this contrivance works is now readily perceived. The gas entering at *H*, exercises its pressure on the water in *A*, which causes a proportionate quantity of water to pass through the syphon into *A'*; with the level of the liquid in *A'* the cork-float and with it the rod is raised, simultaneously, the lever *GF* set in motion, and through all this the influx of gas regulated by its action on the stop-cock *G*.

It is evident, that the consumption of gas by the burner, and bore of conductors, ought not to be calculated for less than the minimum pressure of the gas in the service-pipe.

The only portion of this apparatus requiring particular nicety in adjusting is the stop-cock *G*, which turns in a perfectly cylindrical bore, and though of the utmost susceptibility to the action of the crank *GF*, is perfectly air-tight.

For the Journal of the Franklin Institute.

Tubular Boilers for Western River Steamboats.

Some of the engine builders in Cincinnati and Pittsburgh, are introducing into boats now constructing for service upon the Ohio and Mississippi Rivers, boilers in which the return heat is conveyed through tubes, instead of large flues. This is one of the most important changes that has been made in Western steamboat motive apparatus, since its establishment upon these rivers; and it is one that cannot fail to produce good results, for, in connexion with the annexed resolution of the Inspectors of Steamboats, fixing the pressure of steam in proportion to the thickness and diameter of the shell of the boiler, it must operate to lessen, if not banish, the disastrous consequences of collapse and explosion. As in the East, no doubt but tubular boilers will be found to give every satisfaction to the engineers under whose charge they shall be placed, when the experience of the constructors shall have perfected them in the best manner of securing the tube ends to prevent leakage; and the best proportion of space between contiguous tubes, to secure evaporative efficiency, with facility of access, for removal of scale and mud. In those noted, the tubes are about fourteen feet long, three inches diameter, and one inch apart; which is closer than usual in the practice of many Eastern marine engineers, who have learned, that the steam producing quality of a tubular boiler, does not depend upon the number of the tubes, but upon the proper proportion between their aggregate area and that of the grates.

When the tubes are crowded in, the excess is not only a wasteful expenditure of costly materials, but is hurtful, as the draft is made sluggish by the too great area; the water capacity of the boiler is diminished; and, the upper rows of tubes are liable to become over-heated from being deprived of intimate contact with the water, the spaces being mainly occupied by the passage of the steam bubbles formed upon the lower tubes and the shell. A preventive of the latter defect would be, increasing the spaces between the tubes of the horizontal rows as they approach the surface of the water; say, for example, where the tubes are of three inches diameter, let the spaces of the bottom row be one inch; of the next row, one and one-eighth; next, one and a quarter, and so on increasing by eighths, or any other quantity that may be determined by the number of the rows. This disposition will also afford a better chance for the insertion of the tools required to loosen the scale upon the lower tubes, and for repairs.

* “*Resolved*—That the following Table is hereby adopted, for the guidance of Local Inspectors in the performance of their duties:

DIAMETER OF BOILERS.

Pressure equivalent to the standard pressure for a 42-inch boiler, $\frac{1}{4}$ -inch iron.”

Wire gauge.	Thick. of iron.	34 ins. in diameter.	36 ins. in diameter.	38 ins. in diameter.	40 ins. in diameter.	42 ins. in diameter.	44 ins. in diameter.	46 ins. in diameter.
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1	$\frac{5}{16}$	169·85	160·41	151·97	144·37	137·50	131·25	125·54
2	$\frac{1}{4}$	158·52	149·72	141·84	134·75	128·33	122·50	117·17
3	$\frac{13}{48}$	147·20	139·03	131·76	125·12	119·16	113·75	108·80
4	$\frac{1}{4}$	135·88	128·33	121·57	115·50	110·00	105·00	100·43
5	$\frac{11}{48}$	124·55	117·63	111·44	105·87	100·83	96·25	92·06
6	$\frac{19}{48}$	113·23	106·94	101·31	96·25	91·66	87·50	83·69
7	$\frac{3}{16}$	101·91	96·24	91·18	86·62	82·50	78·75	75·32

* Copied from a printed card intended for the use of the Inspectors and Engineers of the Western rivers.

W. J.

For the Journal of the Franklin Institute.

The Theory of the Gyroscope. By CHARLES J. ALLEN.

This beautiful and interesting philosophical toy, has excited no little attention of late, and hundreds of them have been sold in this City and elsewhere within the last few weeks. In its present simple form it would seem to be somewhat new, although the *Rotascope* described in this *Journal* by Prof. Walter R. Johnson, in 1831 (vol. viii. 2d Series, p. 361), is, when divested of its outer rings, identical with the Gyroscope of the present day, or at least with the American instrument of that name. The Gyroscopes contrived by Foucault some three or four years since, for the purpose of illustrating the rotation of the earth, are more complicated. But in all these instruments, as well as in that invented by Laplace many years ago, and mentioned in Prof. Johnson's article above referred to, the same principle is illustrated, viz: the inertia of the plane of rotation.

Let us now examine how this principle, in conjunction with gravita-

tion, produces the seemingly paradoxical behaviour of this little instrument;—why it is that if a heavy wheel rapidly rotating on a horizontal or inclined axis, be supported on a point, or by a string, *at one end only* of that axis, the unsupported end will not fall, but the whole instrument will revolve nearly horizontally about the point of support, the axis gradually—at first very gradually—approaching the vertical position.

Let the circle $A B D E$ (Figs. 1 and 2), represent the position of the wheel when the instrument is first placed on the point of support, and the hand is disengaged from it. In fig. 1, we are supposed to see the wheel from a position directly in front, and the point of support (being behind the centre c) is not represented. In fig. 2, we see the wheel nearly edgewise, but partly *in front*; s is the point of support, and $s c$ the axis of rotation. The arrows indicate the direction of the rotation, and the same letters mark corresponding parts in the two figures.

Fig. 1.

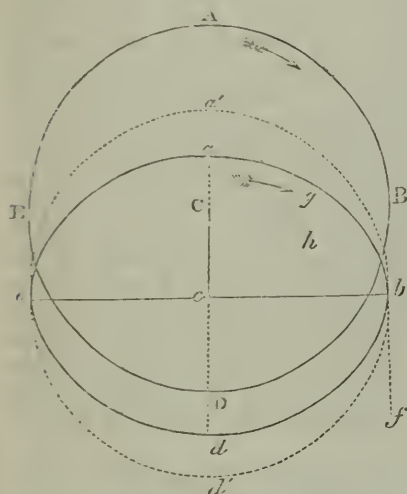
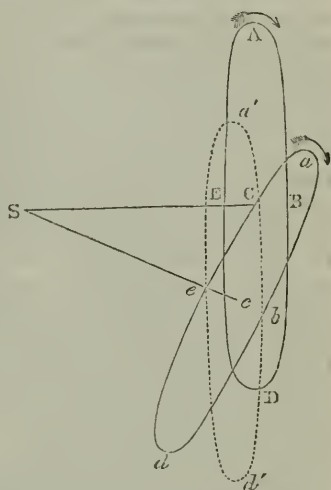


Fig. 2.



Now, suppose the wheel and its attachments, by virtue of their weight, to fall a short distance, the centre c describing about the point of suspension s , the arc $c c$. The wheel has now the position $a b d e$. Let $a' b' d' e'$ be a circle about the centre c , and parallel to the original circle $A B D E$. Then $a' b' d' e'$ represents the position the wheel would have, had it fallen to its new centre c , and at the same time retained the parallelism of its plane of rotation. Now, it is a well known principle, and a necessary result of the *inertia of the direction of motion*, that if the position of a rotating body be changed, it will, if not prevented by other forces, preserve the *parallelism* of its plane of rotation. This arises from the refusal of the centrifugal *tangents* of the corresponding parts of the rotating body to change *their direction*. Hence, if the wheel fall, as supposed above, and at the same time be forced to assume the position $a b d e$, it would tend to rotate in the plane $a' b' d' e'$, and a particle at b , would have a centrifugal tendency in the direction of the tangent $b f$, which tangent is not in the plane $b d e$, but *in front* of it in the plane $b d' e$, this tangent representing the original direction of motion in that part

of the plane of the wheel before the wheel had fallen from its first position. This tangential force may be resolved into two forces, viz : a tangential force lying in the plane $b d e$, and a force acting perpendicularly to that plane, the latter tending to draw the particle at b *forwards* out of the plane of the wheel. This result is produced not only at b , but on every particle of the wheel to the right of the vertical diameter $a d$; as may be shown by drawing circles parallel to $A B D E$, through any points g, h , in $a b d$. The effect is a maximum at b (the extremity of the horizontal diameter), and it vanishes along $a d$. In the same way we find that the tendency of every particle in the wheel to the left of $a d$, is to fly off in a tangent *behind* the plane $d e a$. Hence, there is a tendency to curve the *right* hand half $a b d$ of the wheel *outwards* from the point s , and to curve the *left* hand half *inwards* towards the point s . The result is a revolution in the direction $b e$, around the point s .

Having thus established a horizontal orbital revolution of the wheel about the point s , let us next consider the effect on the wheel of *this* motion in connexion with its rotation. By precisely the same train of reasoning as above, we will find that as a movement of the wheel in the direction $c c$, about the point s , produced a curving tendency *outwards* of the *right*-hand half, and a curving tendency *inwards* of the *left*-hand half, so a movement in the direction $c e$, will produce a curving tendency *inwards* of the *upper* half $e a b$, and a curving tendency *outwards* of the *lower* half $b d e$. Now, the effect of this is to *tend* to *raise* the wheel and its attachments, and produce a revolution about s , in the direction $c c$. But this *tendency* upwards is opposed by gravitation—the weight of the wheel &c.,—and it does not *overcome* this opposing force, it does not quite equal it; it may be made to approach nearer and nearer to it by increasing the velocity of rotation of the wheel. Were it possible to increase this velocity until it reached that *unlimited limit* called by mathematicians *infinity*, the little instrument would stand out stiff and unmoved, without revolution about the point of suspension, and without falling the least distance from its place.

We see from the foregoing that the tendency of the instrument to fall describing a *curve* about the point of suspension, produces an orbital revolution about this point; and that this revolution produces an upward tendency which partly balances gravity, but gravitation has sufficient ascendancy to produce a continual, though very gradual, descent; which descent maintains the orbital revolution.

The theory of the Gyroscope indicated in this hastily prepared article, is offered by the writer as accounting for its singular movements. It is believed to be consistent with itself, and with the varied experiments he has yet seen tried with this interesting instrument. Not having met with any other explanations of the subject, he does not know how they may correspond with the above.

There are several interesting points that should have been treated of in this article, more particularly the result of the conflict of the curving tendencies from the downward and the horizontal motions: but want of leisure, and the necessarily restricted limits of this communication, prevent the writer from enlarging more at this time. He may possibly resume the subject in a future number of the *Journal*.

Philadelphia, 5th Month 19th, 1856.

*On the Commercial Economy of Working Steam Expansively in Marine Engines.** By Mr. EDWARD E. ALLEN, of London.

(Continued from page 338.)

In the paper read at the last meeting, the author endeavored to trace out the effects which would result from working steam more expansively than is usual in marine engines. These effects were considered with respect to the increased weight of the engines, and space occupied by them, and the increased capital required; and also with respect to the saving in weight and cost of coals, and increase of cargo-space occasioned by a less quantity of coals being used for any given voyage.

The various calculations were based on the supposition that the usual practice is to cut off the steam at $\frac{2}{3}$ ths of the stroke; and the cylinders were supposed to be increased in capacity to $1\frac{1}{2}$, 2, $2\frac{1}{2}$, and 3 times successively, in order to effect greater expansion.

By doubling the capacity of the cylinders, it would be found that the steam must be cut off at about $\frac{1}{4}$ th of the stroke; and by increasing them to three times, it must be cut off at about $\frac{1}{5}$ th of the stroke, in order that the actual power developed may in all cases be the same, and the economy would arise simply from the steam being more expanded in the larger cylinders proposed to be substituted for those ordinarily in use. The pressure of the steam was supposed the same in each case; and the quantity of coal, presumed to be used by marine engines, was based on the supposition that steam of about 20 lbs. pressure per square inch above the atmosphere was employed.

In accordance with the wish expressed at the last meeting, the author now proposes to consider the question of economy arising under different circumstances, namely, an increase in the pressure of the steam employed. There are several ways in which economy may be obtained:—1st, by working steam of the ordinary pressure more expansively than usual; this being the mode of economizing pointed out in the paper read at the last meeting: 2d, by using steam of a higher pressure and expanding to the same extent, or in the same degree, as is now usually the case, namely, about $1\frac{1}{2}$ time, or cutting off at $\frac{2}{3}$ ths of the stroke: and 3d, by using steam of a higher pressure, and allowing it to expand much more than is now usually the case, or down to, say, 5 lbs. per square inch above a vacuum as a practical limit.

Thus economy would arise simply from using steam of a higher pressure, but still greater economy would result from allowing such high pressure steam to expand fully. To render this matter clear, it will be necessary to refer to a Table given in the paper read at the last meeting:—

Spaces occupied by steam,	1	2	3	4	5	6	7	8	9	10
Power developed,	1	1.7	2.1	2.4	2.6	2.8	3.0	3.1	3.2	3.3

The quantity of steam being the same in all cases, but allowed to expand so as to occupy the increased spaces.

In this Table no allowance is made either for back-pressure, or for a reduction of power owing to a reduction of temperature while expand-

* From the London Artizan, Feb., 1856.

ing, which, if taken into account, would rather reduce the amounts given. With this exception, however, the ratios of power gained by expansion, as shown in the Table, may be considered as correct for all pressures of steam, or, in other words, the same relative advantage would follow from expanding 1 cubic foot of steam into 3 cubic feet, whether the pressure were 15 lbs. or 120 lbs. on the square inch, the gain from expansion alone being in the ratio of about 2 to 1.

The high-pressure steam would, however, be more economical than the low-pressure, as will be seen from the following Table XIX., which gives the power developed, and the volumes of steam at various pressures formed from the same volume of water, and consequently from the combustion of the same quantity of fuel. The fourth column gives the ratios of power developed, when the steam is used *without expansion*, a back-pressure of 2 lbs. being deducted. The fifth column gives the ratios of power developed when the steam is expanded down to 5 lbs. per square inch above a vacuum, and a back-pressure of 2 lbs. deducted; and the sixth column gives the part of the stroke at which the steam must be cut off, so as to expand down to 5 lbs. Column 7 gives the consumption of fuel required to develop the same power, ordinary practice being taken at 100; and column 8 the per centage saving of fuel deduced from column 7. The last column gives the ratios of the capacity of cylinder required in each case to develop the same power, and to allow of expansion down to 5 lbs., the ratios being calculated from the size of the cylinder required for 35 lbs. steam, cut off at $\frac{3}{4}$ ths, which is taken as 1.

TABLE XIX.

Table showing the power developed and the volume of steam at different pressures, produced from the same volume of water, and consequently with the same consumption of fuel.

Total pressure (including atmosphere) in lbs. per square inch.	Volume of water.	Volume of steam.	Steam not expanded, but back-pressure of 2 lbs. deducted. * Ratio of power developed compared with ordinary practice.	Steam expanded down to 5 lbs. pressure, and back-pressure of 2 lbs. deducted.				
				Ratio of power developed, * compared with ordinary practice.	Part of stroke at which steam must be cut off to expand to 5 lbs.	Consumption of fuel for the same power, in per centage of ordinary consumption	Per centage saving of fuel for the same power.	*Capacity of cylinder required for the same power.
15	1	1660	*66	1.24	1-2.7th	Per cent. 80	Per cent. 20	31 $\frac{1}{2}$
20	1	1281	*71	1.46	1-3.5	68	32	33 $\frac{1}{2}$
25	1	1044	*74	1.64	1-4.3	61	39	23 $\frac{1}{2}$
30	1	883	*76	1.78	1-5	56	44	21 $\frac{1}{2}$
35	1	767	*78	1.91	1-6	52	48	20 $\frac{1}{2}$
40	1	679	*80	2.02	1-6.6	49	51	20 $\frac{1}{2}$
50	1	554	*82	2.22	1-8	45	55	18 $\frac{1}{2}$
60	1	470	*83	2.37	1-10	42	58	17 $\frac{1}{2}$
70	1	409	*84	2.50	1-11	40	60	16 $\frac{1}{2}$
80	1	353	*85	2.62	1-12.6	38	62	15 $\frac{1}{2}$
90	1	316	*86	2.66	1-14	37	63	15 $\frac{1}{2}$
100	1	287	*87	2.83	1-15.6	35	65	15 $\frac{1}{2}$
110	1	266	*89	2.91	1-17	34	66	15 $\frac{1}{2}$
120	1	250	*92	3.00	1-18	33	67	14 $\frac{1}{2}$

* Ordinary practice is assumed at 35 lbs. total pressure, cut-off at $\frac{3}{4}$ ths of the stroke, the power developed being called 1.

** The size or capacity of cylinder in ordinary use, i. e., for 35 lbs., steam cut off at $\frac{3}{4}$ ths, is taken as 1.

Allowance is made in this Table for the reduction of pressure arising from a reduction of temperature during expansion, and the difference this makes may be understood by seeing, from the Table, that steam of 120 lbs. pressure, expanded 18 *times* only, reduces the pressure to 5 lbs. per square inch; whereas, if no reduction of pressure took place from a reduction of temperature during expansion, steam of 120 lbs. would have to be expanded 24 *times* (instead of 18 times as above) to reduce it to 5 lbs. pressure.

The Table also shows how the ordinary practice may be improved upon; for example, by using steam of 120 lbs. pressure, and cutting off at $\frac{1}{8}$ th of the stroke, in which case 3 times the power will be developed from the same combustion of fuel.

As the final pressure is here supposed to be 5 lbs. in all cases, it follows that the size or capacity of cylinder required is in all cases the same, namely, about 4500 times the bulk of water evaporated. In ordinary practice the capacity of cylinder may be taken at about 1000 times the bulk of water evaporated; so that with 120 lbs. steam, cut off at $\frac{1}{8}$ th of the stroke, although 3 times the power is obtained by the same combustion of fuel, yet the capacity of the cylinder must be about $4\frac{1}{2}$ times that required for steam at 35 lbs., and cut off at $\frac{3}{4}$ ths. It follows from this, that the *same* power would be developed in a cylinder $1\frac{1}{2}$ times the ordinary size.

In like manner, with steam of 50 lbs. total pressure expanded to 5 lbs. (2 lbs. back-pressure allowed), the steam would require to be cut off at about $\frac{1}{8}$ th of the stroke; and in order to develop the same power as in ordinary practice, namely, 35 lbs. cut off at $\frac{3}{4}$ ths, the capacity of the cylinder must be just doubled.

The amount of economy obtained by using steam at increased pressures may be found from column 5. For instance, steam at 50 lbs. pressure, cut off at $\frac{1}{8}$ th, gives 2.22 times the power obtained in ordinary practice (that is, with 35 lbs. steam, cut off at $\frac{3}{4}$ ths); and in like manner, steam of 120 lbs., cut off at $\frac{1}{8}$ th, gives 3 times the power; so that the *same* power is obtained by the combustion of 45 and 33 per cent. of the fuel, or, in other words, the saving in these cases is about 55 and 67 per cent. respectively.

In comparing this economy, due to the use of high-pressure steam, with that shown in the former paper to result from the greater expansion alone of steam of 35 lbs. total pressure, the difference is very marked; for in the latter case, increasing the size of cylinder to $1\frac{1}{2}$ times, the economy was only 19 per cent.; whereas, with the same increase in size of cylinder, and 120 lbs. of steam, the saving is 67 per cent., or $3\frac{1}{2}$ times as great. Again, doubling the size of cylinder with 35 lbs. steam, the saving was 29 per cent.; whereas, with double the size of cylinder, and 50 lbs. steam, the saving is 55 per cent., or nearly double.

It would occupy too much space to pursue the investigation so far as to exhibit at full length the economy resulting from employing steam of *increased pressure* in cylinders of the *increased sizes* assumed in the previous paper; but the cases may be considered in which the size or nominal H. P. of the engines is increased to 1, 2, and 3 times, the intermediate sizes being omitted.

The comparative results are given in the following :—

TABLE XX.

Table showing the relative economy of obtaining the same power by using steam of increased pressure, and by increasing the size or nominal H. P. of the engines from 1 to 2 and 3 times (the intermediate sizes being omitted.) Back-pressure allowed of $3\frac{1}{2}$ lbs.

Total pressure of steam in lbs. per square inch.	Ratio of size of nominal H. P. of engines.								
	1			2			3		
	Cut off at	Final pressure in lbs. per sq. inch.	Ratio of coal con- sumed.	Cut off at	Final pressure in lbs. per sq. inch.	Ratio of coal con- sumed.	Cut off at	Final pressure in lbs. per sq. inch.	Ratio of coal con- sumed.
35	3-4th	$25\frac{1}{2}$	100	1-4th	$7\frac{1}{2}$	66	1-7th	$4\frac{1}{2}$	57
40	2-5	$14\frac{1}{2}$	68	1-6	$5\frac{3}{4}$	57	1-10	$3\frac{1}{2}$	51
50	1-3-3	$13\frac{1}{2}$	58	1-8	5	48	1-13	3	45
60	1-4	13	53	1-9-5	$4\frac{7}{8}$	45	1-15	3	42
70	1-5	12	48	1-12	$4\frac{1}{2}$	41	1-18	3	39
80	1-6-6	10	43	1-15	$4\frac{1}{4}$	38	..	..	..
90	1-8	$9\frac{1}{4}$	40	1-18	4	36	..	..	..
100	1-10	$8\frac{1}{4}$	38	1-22	$3\frac{3}{4}$	35	..	..	..
110	1-11	8	37	1-24	$3\frac{3}{4}$	34	..	..	..
120	1-12	$7\frac{3}{4}$	35	1-26	$3\frac{1}{2}$	32	..	..	..

From this Table it appears that a choice may be frequently made between two ways of employing steam, both resulting in the same economy, so far as the consumption of coal is concerned. For instance, steam at 50 lbs., cut off at $\frac{2}{10}$ ths, and steam at 35 lbs., cut off at $\frac{1}{4}$ th, give the same results, or nearly so; but the low-pressure steam requires a cylinder of 3 times the capacity of the other.

Again, steam at 70 lbs., cut off at $\frac{1}{5}$ th, and steam at 50 lbs., cut off at $\frac{1}{3}$ th, give the same results; but the low-pressure steam requires a cylinder of double the capacity of the other.

The results have not been carried out in the third series of columns for pressures above 70 lbs. as the final pressures fall too far below the assumed back-pressure.

The consideration of the subject will now be confined to the economy that would be effected by using steam of *increased pressure* in a cylinder of the *ordinary size*.

The following Table XXI. has been compiled in order to show with what economy steam with increased pressure can be expanded in a cylinder of the ordinary size so as to develop the same power.

The pressures begin at 35 lbs., cut off at $\frac{3}{4}$ ths, which is assumed as the ordinary practice, and the power developed under these conditions is called 1. Column 1 gives the total pressures; column 2 the part of the stroke at which the steam must be cut off in each case to develop the same power; column 3 the ratio of the power developed by the same consumption of coal; column 4 the relative quantities of coal required to develop the same power; column 5 the per centage saving of coal; and column 6 the final pressure of the steam on its exit from the cylinder.

From this Table it will be seen that in the case of an engine working with 35 lbs. steam and cutting off at $\frac{3}{4}$ ths of the stroke, if it be required to increase the pressure (in order to economize) to say 70 lbs., then the

steam must be cut off at about $\frac{1}{3}$ th of the stroke, and the consumption of coal will be only 48 per cent. of the quantity previously consumed, the power developed remaining the same. So, also, if the pressure be increased to 120 lbs., the steam must be cut off at about $\frac{1}{3}$ th of the stroke and the consumption will be reduced to 35 per cent., the same power being developed. The size of the cylinder remains the same in all cases.

With respect to the weight of machinery, it will not make much difference to what pressure the steam is raised; for although the weights slightly decrease when high-pressure steam is used, yet the difference is very little, and not worth considering in the present investigation.

TABLE XXI.

Table showing the economy of working steam of increased pressure in a cylinder of the ordinary size.

Total pressure of steam in lbs. per square inch.	Part of stroke at which steam is cut off to develop same power.	Ratio of power developed by same consumption of coal.	Ratio of coal required to develop same power.	Saving of coal in per centage on ordinary consumption.	Final pressure of steam on leaving cylinder in lbs. per square inch.
35	3-4th	1-00	100	Per Cent.	25 $\frac{1}{2}$
40	2-5	1-47	68	32	14 $\frac{1}{2}$
50	1-3-3	1-72	58	42	13 $\frac{1}{2}$
60	1-4	1-88	53	47	13
70	1-5	2-06	48	52	12
80	1-6-6	2-28	43	57	10
90	1-8	2-44	40	60	9 $\frac{1}{4}$
100	1-10	2-60	38	62	8 $\frac{1}{2}$
110	1-11	2-70	37	63	8
120	1-12	2-80	35	65	7 $\frac{3}{4}$

(To be Continued.)

Mechanical Engineering as applied to Farm Implements.

By H. HOWSON, Civ. Eng.

(Continued from page 260.)

Machine for cutting Hemp, Corn, Sugar Cane, and Cotton Bushes.

Patent granted to William B. Coates, October 15th, 1850.

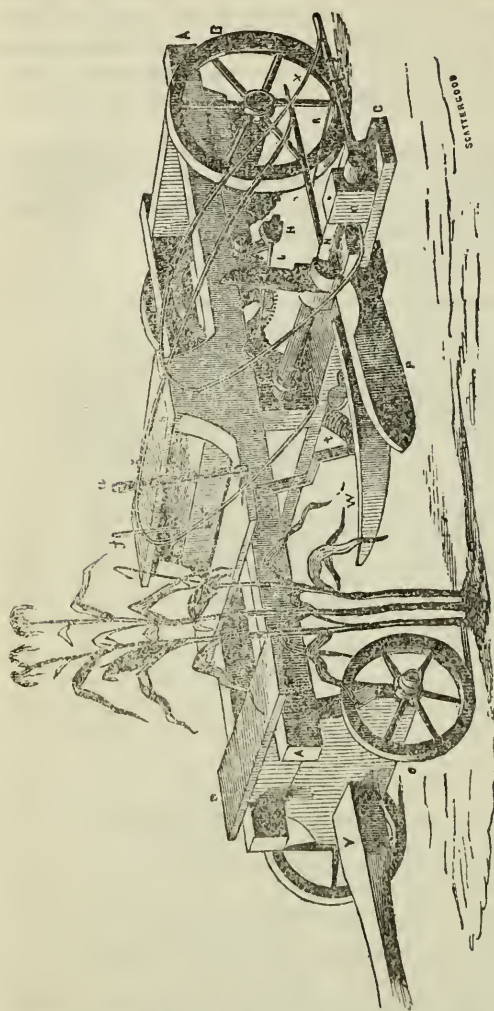
This ingenious labor-saving apparatus, represented in the annexed perspective view, consists of two longitudinal beams A, which, with their connecting cross pieces, form the main frame of the machine.

Underneath the back end of the frame, are boxes for receiving the axle, on which are secured the main driving wheels B.

On a pin underneath the cross piece at the front end of the frame, swivels a block, to the ends of which, are hung the wheels e, e, and to this block is secured the pole, by which the whole apparatus is drawn and guided over the ground.

At right angles to the framework, and near the middle of the same, projects the out-rigger or bracket c, and to the latter are secured the two guide teeth or fingers w and p, the latter being permanent, and the former

adjustable, so that the space between the two may be increased or diminished at pleasure.



The finger *p*, has on the inside a cutting edge, arranged to coincide with the cutting edge of the knife or chopper *n*, when the latter is brought down by the action described hereafter.

The chopper *n*, is permanently secured to the shaft *n*, which has its bearing at one end in the box *o*, at the end of the out-rigger *c*, and at the opposite end in a box, secured to a continuation of the out-rigger between the beams *A*, *A*, of the main frame.

The end of the shaft *n*, which fits into the latter box, has a portion of a screw cut on its surface, which is adapted to a similar portion of a screw in the box, so that when a reciprocating motion is communicated to the shaft *n*, it at the time receives a lateral reciprocating motion.

n is a crank attached to a shaft, which has its bearings on the underside of the opposite beams *A* of the frame, and this shaft is so connected by a system of gear wheels to the axle of the driving wheels *B*, as to receive a rapid motion

when the machine is drawn over the ground

To the end of the crank *n* is connected, by means of a universal joint, the rod *j*, the opposite end of which is jointed to a crank *m* on the shaft *n*. From the back of the out-rigger *c* projects two bars, to the ends of which are attached the rods *x*, *x*, the latter are bent and pass over the out-rigger to the front of which they are connected, one on each side of the fingers *w* and *r*.

Underneath the bars which project from the back of the out-rigger, are staples for receiving the rod *k*, which is connected to a horizontal lever under the out-rigger, the lever being connected by means of a rod

to the vertical lever *u*; a spiral spring *t*, being so connected with the horizontal lever, as to maintain the rod *R*, in its position across the two projecting bars when not removed by operating the lever *u*. Another lever *f* is so arranged in connexion with the gearing, for actuating the shaft *s*, that the motion of the latter may be instantly stopped.

Both levers *n* and *f* are so situated as to be within reach of the driver, who sits on the platform *s*.

The machine is drawn over the ground, and so directed that the stalks to be cut shall pass into the space between the two fingers *w* and *p*, where they are submitted to the action of the chopper *n*, which has a rapid movement imparted to it, by the system of gearing above alluded to.

The screwed end of the shaft *x*, directs the chopper as it descends in an oblique direction, thus effectually cutting the stalks that have passed between the fingers *w* and *p*.

The upper portion of the stalks or bushes thus cut, fall over the out-rigger on to the rod *R*, and when a sufficient number have been collected on the latter, the driver, by means of the lever *u*, withdraws the rod, and allows the bundle of cut stalks to drop on to the ground.

The above described arrangement of one chopper answers well for cutting corn, sugar cane, and cotton stalks. When the machine is used for cutting hemp, however, or any broad cast crops, several straight teeth cast in one piece, will be required to slide on the out-rigger *c*, and several choppers to suit. The inventor is at present engaged in simplifying and perfecting his apparatus, so as to reduce the cost and render it a serviceable and economical farm implement.

During the last five or six years, considerable attention has been paid to improvements upon windmills, and a variety of plans, all more or less efficient, have been suggested and carried out for the purpose of rendering them serviceable for farm purposes.

As a specimen of a recently invented and constructed windmill and one in the design of which no little ingenuity is exhibited,

Halladay's Patent is here selected for Illustration.

Figure 1 is a perspective view, and figure 2 is a face view of the wing or sail ring, and parts of the governor.

The nature of the invention consists in having the wings or sails attached to movable or rotating spindles having levers or equivalent devices connected to them, said levers being also connected to a head with wings rotating on the same shaft. The head has a lever connected to it, which is operated by a governor that slides the head upon the shaft, and causes the levers or their equivalents, to turn the wings or sails, so as to present a proper resisting surface to the wind, and thereby produce a uniform velocity of the sails, which are made to have a greater or less obliquity, according to the velocity of the wind.

A represents a horizontal shaft, which works in suitable bearings *a a* upon a cap, or turn-circle *B*; said cap turns loosely upon friction rollers working in the circular plate or bed piece, which is firmly braced and bolted upon the top of the upright timber.

Fig. 1

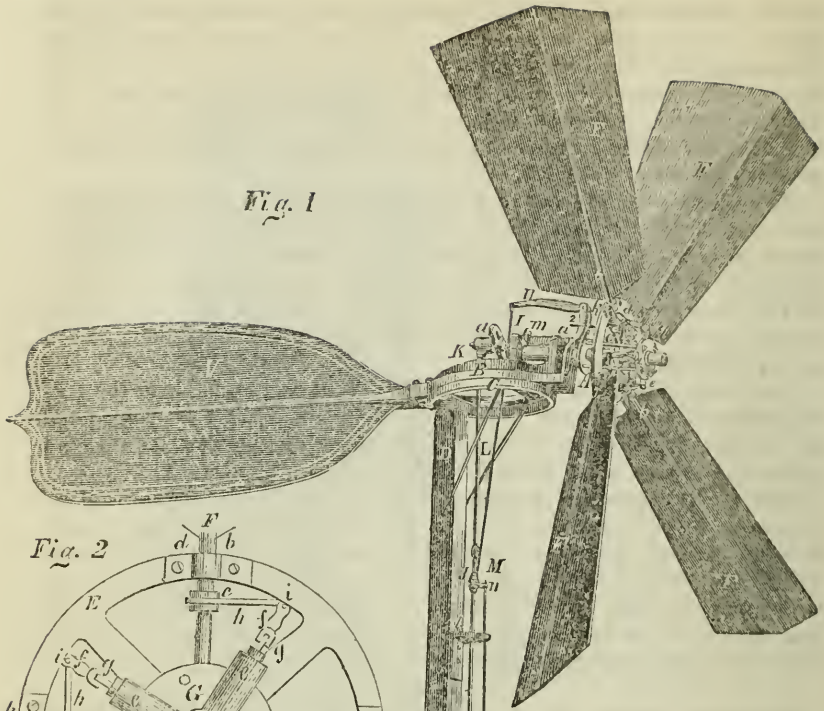
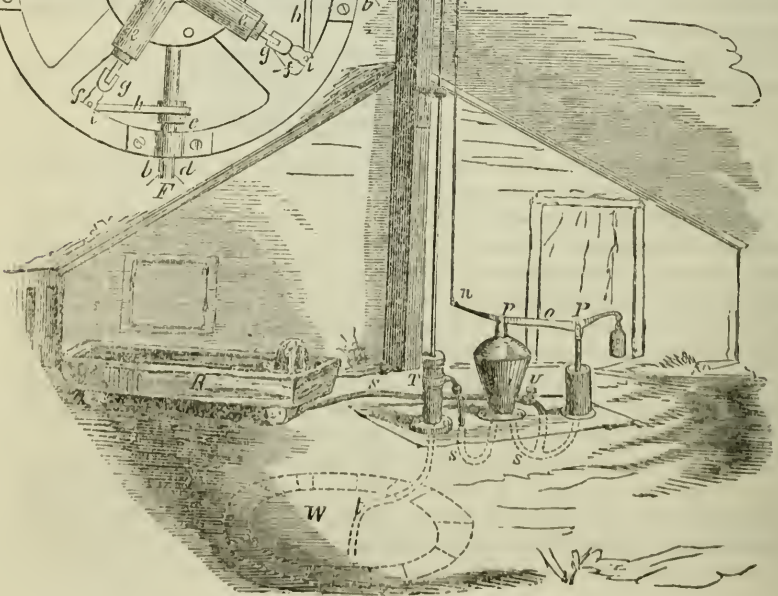
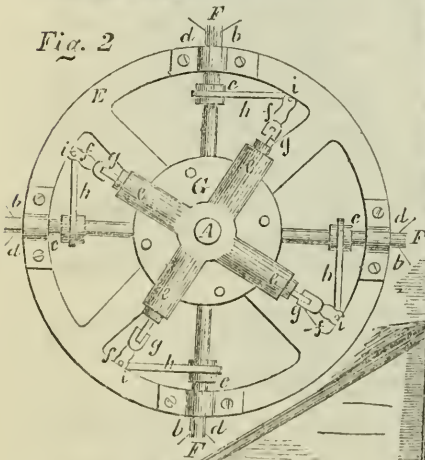


Fig. 2



The shaft *A*, projects some distance beyond the edge of the cap, or turn-circle, *B*, and has a wheel *E*, figure 2, attached permanently to it.

F, represents the wings or sails, which are secured to spindles, *b*, said spindles passing radially through the rim of the wheel, *E*, and into its hub, the spindles being prevented from withdrawing by collars, which bear against the inner edge of the rim and caps, which are secured by screws over the spindles, the spindles being loose in the wheel *E*, and allowed to turn upon their axes. Four wings or sails are represented, but any proper number may be used. *G*, is a hub fitted loosely upon the shaft, *A*, and having projections *e*, at its front end, to which projections small levers, *f*, are attached by pivots, *g*, the outer ends of the small levers, *f*, being secured to the ends of levers, *h*, by pivots, *i*. The levers, *h*, are secured permanently to the spindles, *b*, as shown in figure 2. The inner end of the slide-head has a groove turned on it, in which groove a forked lever, *u*, fits, figure 1. The lever *u*, is bent, and has its fulcrum at *k*, and to the outer end of it, a wire or rod, *r*, is attached, said wire or rod passing down through a sleeve, moving loosely upon a square iron rod, which forms part of the connecting rod; the outside of said sleeve forms a bearing, and moves in a guide which is attached to the upright post, (this guide or box in which the bearing of the sleeve works, is attached to a piece of plank, and is sent with the mill, the plank guides in which the wood connecting rod works, are made by the joiner who erects the post, &c.); after passing through the sleeve, the lower end of the wire or rod is screwed into the boss, which also works upon the square rod mentioned above. This sliding head or boss, *m*, has a recess or groove in it, which the fork, *n*, fits; this fork is fastened near the centre of a round iron rod, and works in two small cast iron guides, which are fastened to the upright post; the lower end of said rod has a hole drilled in it, in which a rod or wire is fastened, the lower end being secured to the end of lever, *o*, at *n*, near the pumps. The object of the above described boss or sliding head with fork fitting in the recess, is to allow the mill, and consequently the connecting rod, to turn around, as the wind changes, without disturbing the stationary regulating rod or wire, attached to the end of lever, *o*, at *n*. The opposite end of lever, *o*, is attached by a pivot to a piston rod, *p*, the piston of which works within a cylinder. *R*, is a reservoir containing water, and *s*, is a pipe which projects over the top of said reservoir, the opposite end of the pipe communicates with the outside cylinder, reservoir, *R*, and a pump, *t*, at their bottoms, as in dotted lines, figure 1. The rod *j*, it will be seen, is the piston rod of the pump *t*; *v* is a cock in the pipe, *s*. In case the shaft, *A*, revolves too rapidly, the cock, *v*, is somewhat turned so as to check the free passage of water through the pipe, *s*, and the water will then be forced against the under side of the piston of the outside cylinder, and will raise it, and the head or boss, *m*, will consequently be moved down upon the rod, *j*, and the wire or rod, *r*, will draw downward the horizontal arm of the lever, *u*, while the vertical arm will force outward the head, *G*, on the shaft, *A*, and the levers, *f h*, will turn the spindles, *b*, and the wings or sails, *F*, move obliquely to the wind, and the motion of the mill will be decreased in a corresponding degree. When it is desired to increase the motion of the mill, the cock, *v*, is

opened, and the water having a free passage through the pipe, *s*, the head or boss, *m*, is raised upon the rod, *j*, and the head, *g*, on the shaft, *a*, brought back to its original position, by the weight upon lever, *x*, the wings or sails presenting a greater surface to the wind.

In figure 1, the pump is represented as drawing water through the suction pipe, *t*, from a well, *w*, and forcing it through the air chamber into the reservoir. A crank being on the shaft, *a*, on the horizontal revolving head, and the rod, *i*, connected to this crank, a reciprocating motion is given to the piston of the pump, thus drawing and forcing out the water by single stroke alternately. With one valve opening inwards, and one outwards in the bed plate of the pump cylinder, it can work as a single-acting force pump, driving the water through the air chamber into the reservoir without any other connexions of apparatus.

v is a vane attached to a cap or turn-circle, for the purpose of keeping the wings or sails, *r*, facing the wind.

x is a straight lever, working upon a standard which is held to its place by one of the bolts which secure the cap on the inner bearing to the main shaft. In one end of this lever, is made a slot, which works on a pin, which will be found fastened into the bent lever, *h*, upon the other end is a sliding iron weight, which keeps the sails spread to the wind.

Instead of discharging the water through branch pipe near *s*, in figure 1, the top of the copper cylinder is covered, and the piston rod works through a stuffing box, the water passes through the copper cylinder and is discharged through a side pipe near the top of the cylinder. The piston rod works inside of a long brass ferrule or pipe, at the upper end of which is a handle or lever. At the lower end is attached a round brass plate, just filling the copper cylinder, designed to move or slide around upon the upper side of the plate or piston, which is attached to the lower end of the piston rod; holes are made through these plates, and when moved upon each other, they operate like a range, opening and closing the water passages through them. If the range is perfectly closed, it will be readily perceived, the whole power of the pump forces the water against the under side of the piston, thus raising the lever *o*, and drawing down the regulating wire or rod, which will change the obliquity of the sails, till only their thin edge is presented to the wind.—It will be perceived when the principle of the regulator, which is represented in the cut, is thoroughly understood, that when a very high column of water is to be forced up and this regulator used, a heavy weight must be attached to the lever, sufficient to balance the column of water, and hold down said lever, while the mill and pump are at rest, or doing their appropriate work. But in using the water regulator, not represented in the cut which we have described, a small weight only is used, just sufficient to overcome the friction in the stuffing box, and cause the lever to drop, the weight being the same in all cases. The turning the stop-cock accomplishes the same object in the one case, as the turning the range does in the other.

Mills on the above plan, are manufactured to a considerable extent, by the Halladay Windmill Company, South Coventry, Connecticut.

(To be Continued.)

Translated for the Journal of the Franklin Institute.

Note on the Latent Heat of Vapors: By M. LEGRAND, PROFESSOR of Astronomy in the Faculty of Sciences, of Montpelier.

(Read before the Academy of Sciences of Paris, 4th February, 1856.)

We calculate the latent heat of vapors erroneously, because we do not take into consideration their specific heat, and we are thus prevented from seeing the very simple law which appears to govern it. In fact, we imagine, frequently, without saying so, that the vapor condenses at the temperature at which it enters the worm; and we establish the formula, as if from that moment it possesses the same quantity of heat as an equal amount of liquid at the same temperature. But we should bear in mind that at the moment it changes its state, it suddenly changes its specific heat, and takes a higher one. By operating as if it was a liquid at the same temperature, we attribute to it more free heat than it has in the state of vapor, and we take this excess from the latent heat, which is consequently found too low.

It appears to me that we ought to proceed as follows: Let t, m, c , be the temperature, weight, and specific heat of the saturated vapor; t', m', c' the initial temperature, weight, and specific heat of the liquid employed for the condensation (the worm included); t'' the final temperature of this liquid, and x the latent heat of the unit of weight of the vapor. The liquid, after condensation, has the mass $m+m'$, and its quantity of heat above 0° (Cent.) is $(m+m') c' t''$. It is composed of what it was at first $m' c' t'$, plus the free heat $m c t$, of the vapor above 0° , plus the latent heat $m x$; we have, therefore,

$$m c t + m x + m' c' t' = (m+m') c' t''$$

$$x = \frac{m' c'}{m} (t'' - t') - c t + c' t'', \text{ for the latent heat of the}$$

$$\text{unit of weight, and } x + c t \text{ or } x = \frac{m' c'}{m} (t'' - t') + c' t'', \text{ for the total heat.}$$

$$\text{By the common reasoning we should have the latent heat } = y = \frac{m' c'}{m}$$

$$(t'' - t') - c' t + c' t'', \text{ and for the total heat } = Y = y + c' t = \frac{m' c'}{m}$$

$$(t'' - t') + c' t''.$$

For the total heat, the formulæ coincide; they differ for the latent heat; but it is precisely this latter which appears to follow a very simple law. It will be seen that I suppose the condensing liquid as of the same nature with that condensed. It will also be seen that I count the temperature of the vapor from 0° : it would not be difficult to modify the formulæ so as to count from any other temperature, but 0° appears to merit the preference, at least for the vapor of water, what I have chiefly in view.

To apply the formula of latent heat to the vapor of water, I cannot do better than to borrow the formula resulting from M. Regnault's experiments. Calling t the temperature of the vapor, and l the total heat for

the unit of weight, he found that from 0° to 230° (Cent.,) the experiments accord in the most satisfactory manner with the formula.

$$l = 606.5 + 0.305 t, \text{ or } l = 0.305 (1988.5 + t).$$

To deduce the latent heat from this, we must subtract $c t$ from l . But c in this place can be neither the specific heat under constant pressure, nor under constant volume, for they cannot be taken without passing the vapor into the state of gas, or in part into the liquid state. For vapors saturating space, which are neither gas nor liquid, there is no other specific heat than that defined by M. Regnault; that is, the quantity of heat which it is necessary to give to 1 kilogramme of saturated vapor, to elevate its temperature 1° , while at the same time this vapor is compressed so as to maintain the state of saturation; in other words, it is

$$\frac{dl}{dt} \text{ or } 0.305. \text{ But if from } l \text{ we subtract } 0.305 t \text{ there remains } 606.5;$$

that is to say, *the latent heat, calculated as I have explained it, is constant.* In terms, this is Southern's law; in fact it is materially different. Understood as I have explained it, it appears to me that it must be admitted as a legitimate deduction from M. Regnault's experiments.

Translated for the Journal of the Franklin Institute.

Description of a New Interference Apparatus, and some of its Uses.

By M. J. JAMIN.

M. de Senarmont presented to the Academy of Sciences of Paris, at their Session of 10th March, a note of M. Jamin, describing a new piece of optical apparatus.

The construction of apparatus for exhibiting and establishing the smallest difference in the velocity of two luminous rays, which had passed through equal thicknesses of unequally refracting media, has long been proposed. M. Soleil Duboseq constructed for Arago an instrument of this kind, which fulfilled the purpose for which it was constructed, but allowed serious inconveniences to remain. The slight separation of the interfering rays, the excessive narrowness of the fringes obtained, their continued agitation, and above all, the difficulty in adjusting the various parts of the apparatus, have heretofore prevented its employment, restricted its applications, and diminished its sensitiveness. But, were it possible to give to the rays a greater separation, to increase at will the breadth of the fringes and make them immovable, and to simplify the manipulation of the parts, we should have an instrument capable of rendering great service to physical science.

M. Jamin thinks that he has completely resolved this problem, by utilizing the phenomenon of colored rings produced by thick plates. He places, parallel to each other, two pieces of very pure and thick glass, and reflects the light upon the first, which gives two beams, the one reflected from the first, the other from the second surface of the glass; these are the interfering beams, and they will have a separation proportioned to the thickness of the glass. These two beams, meeting the second glass, are again decomposed each into two, as the primitive ray

was by the first glass, and among these four rays thus obtained, there are two which are parallel in direction, equal in intensity and have traversed the same thicknesses of air and glass, and thus give interference fringes. These fringes are broad, luminous and perfectly steady: they may be directed either horizontally, vertically, or obliquely, and what is valuable, they may be so dilated as to give flat tints. In this arrangement there are required, neither a perfectly adjusted narrow slit, nor carefully regulated mirrors, nor lens to view the fringes; the apparatus is reduced to two glasses illuminated by a lamp, and the fringes are seen by the naked eye, spreading themselves out in the image of the glass like the colored rings in the double lens of Newton.

If an opaque body is now placed near to the path of the light, one of the rays may graze its surface, while the other passes at a distance, and if any physical modification is taking place in contact with this body, it is indicated by a deformation of the fringes at the edge of the shadow of the body.

In his note, M. Jamin then describes some applications of his apparatus. When a metal is plunged into water or a saline solution, it is, if oxidizable, always attacked and the fringes deformed. When an electric current is passed through a conducting solution, the chemical decomposition alters the density of the liquid in contact with the electrodes, and the optical phenomenon is changed. By these means we may follow all the chemical phenomena due to the passage of an electrical current.

If the poles of a powerful electro-magnet are placed in a solution of sulphate of iron, the solution is modified, the salt of iron is attracted by the magnet, and the water repelled; the action progressively increases, and the salt of iron finally crystallizes on the poles.

Finally, if a crystal of alum be plunged into a saturated solution of the same salt, the crystal grows by successive additions of the salt, and it may be seen that it attracts the particles of salt from a distance, and consequently augments the density of the solution in its own vicinity, but in actual contact, the index of refraction diminishes, either because the molecules of alum are precipitated upon the salt, and weaken the solution, or in consequence of the disengagement of heat by the crystallization.

*Indestructible Printing on Metallic Plates.** By Dr. J. LOTSKY.

Messrs. Adams and Gee, printers, of London, have found that metallic plates, of the thickness of ordinary sheet tin, may be printed upon with the usual printing type, if the plates be first coated with a whitish composition—the secret of the inventors. If sheets thus printed upon be afterwards subjected to a certain japanning process, an even lustrous surface is produced, which cannot be acted upon except by a sharp steel instrument. The cost of preparing the printed sheets is small.

It requires no great consideration in order to discover that this invention is of a very important character. In the first place, it is evident, that printed metallic sheets of the above description may be substituted with

* From the Lond. Mech. Mag., Nov., 1855.

great advantage for the mounted paper lessons employed for class teaching in schools, which, from the rapidity with which they become worn, are costly apparatus in all public educational establishments. Moreover, as these durable printed sheets may be prepared very economically, the number of class lessons employed may be greatly increased; and, further, these plates may also be used for maps, diagrams, tables, &c.

In the second place, I venture to suggest that important moral effects might be produced in every country by the circulation of such plates bearing extracts from the highest class of literature, and even well selected quotations from the Bible itself. I am aware that maxims and precepts printed upon paper are already in extensive circulation; but, from the destructible nature of the fabric on which they are impressed, I believe they do not assume that importance which would be attached to them were they produced upon a lasting material, and in an artistic style. The lessons which might thus be perpetuated, and kept continually before the mind of youths in particular, might well be expected to counteract some of the evil effects of modern worthless and injurious paper literature, which, from its ephemeral character, has a natural tendency to degenerate.

Again, printed metallic plates of the kind under notice will certainly be substituted, and that with great advantage, for out-door notices, advertisements, &c. Much difficulty is at present experienced, and much trouble occasioned, from the fact that information of great interest and importance to the public is inaccessible, in consequence of the want of a method of so publishing such information that the expense of frequent renewal (which in the case of long printed statements would be very great) shall not be incurred. The invention under consideration supplies such a method. Other applications of the invention will suggest themselves to the reader. For my own part, I believe it capable of such applications as, if mentioned here, would probably be considered extravagant.

15, Gower Street North.

*Moulding Slag Bricks and Coping Stones.**

A communication on the question of slag bricks has been made to the *Society of Arts Journal*, by Mr. Hyde Clarke. He says:—In the South Wales districts the copper works supply slag bricks and coping stones to some extent, the smelters receiving a small fee for moulding. Some of the slag bricks are used even in the copper works. This is the case likewise in the works of the Mexican and South American Smelting Company, at Herradura, Caldera, and Tongoy, in Chili, where the walls of the ore-yards, and even the ash-pits and foundations of some of the furnaces are made of these materials. Rough slag is turned to account in making embankments near some of the Welsh and Lancashire Works, but is very porous. The moles at Herradura and Caldera are filled in with rough slag, and parts of the Tongoy and Herradura works are built on what was lately shore, but now land reclaimed from the Pacific by being covered with slag. One objection to slag bricks, which are otherwise cheap, is their brittleness.

* From the Lond. Civ. Eng. and Arch. Jour., Jan., 1856.

bunks extending alongside the machinery. Has a sunken or trunk cabin aft, having its top flush with rail, and of two inch pine. Main deck of three inch pine. There are three yellow pine keelsons 12×14 extending the whole length of the floor, and firmly secured to the frames. Has a deck house, and above it, forward, a pilot house with steering apparatus. The waterway, outer streak, plank shear, waist and rail, are of wood. Her guards are built light, being required simply to protect the wheels, and are braced by iron knees and tie-bolts with king-posts. They may be removed so that the vessel can pass the canal between the Lakes. This steamship was built in Philadelphia, and left on the 26th May, under steam for Buffalo on Lake Erie, via the St. Lawrence and Welland Canal.

J. V. M.

*Leaden Pipes in the Supply of Water and Beer.**

Having noticed your important article in last Saturday's *Builder*, relative to "leaden pipes in the supply of water and beer," we think it proper to call your attention to the fact, that a patent was taken out on the 19th of April, 1853, by Mr. John Chatterton, a talented engineer of Birmingham, for coating gutta-percha tubing with lead. This combination of gutta-percha and lead secures remarkable strength, and at the same time avoids the danger arising from the use of the ordinary leaden pipes. We have much pleasure in handing you a specimen of tubing (made under Mr. Chatterton's patent), which has been subjected to the extraordinary pressure of 600 lbs. on the square inch, without exhibiting any symptoms of giving way.

THE GUTTA-PERCHA CO.

* * The specimen referred to appears to be well adapted to the purpose in view. The gutta-percha tube enclosed in the leaden one, though not attached to its interior, is perfectly protected by it, and the inner tube is of considerable thickness.

*The Photo-galvanographic Process of Engraving.**

In the hands of Mr. Paul Pretsch, lately the manager of the Imperial Austrian Printing Office at Vienna—the productions of which workshop were so greatly admired in our Exhibition of 1851—light and electricity have at last been most effectively combined, and trained to perform the united functions of the artist, draftsman, and engraver. Drawing by light, and engraving by electricity, are, in themselves, far from new. Every town now possesses its photographers, who enjoy the means of indelibly reproducing not only the outlines, but the nicest lights and shades of both natural and artificial objects, quite independently of the exercise of any purely artistic genius. Similarly, the substantially reproductive power of the electrotypic art, for the purposes of the printer, is a fact of old standing. But the production of printing plates capable of giving us every touch of nature, without necessitating the employment

* From the Lond. Builder, No. 661.

† From the Lon. Prac. Mech. Journal, April, 1856.

either of the pencil of the artist, or the burin of the engraver, is something far advanced beyond even these ingenious scientific applications.

Mr. Paul Pretsch—engaged, as he has been, in the pursuit of science, and improvements in the fine arts, and developing them for the purposes of the printer's multiplying power, under the auspices of a government, which, in this instance, at least, has shown a highly enlightened spirit—was very early impressed with a deep sense of the power conferred upon man by the introduction of photography, and saw clearly enough how much this art was able to assist the real artist in the creations of his own mind, and in multiplying his works. During his photographic trials, he made several experiments upon etching upon metal and stone: but, in adhering to the practice of his predecessors, he got involved in the inconveniences due to the necessity of etching several times for the production of different tints. It was whilst these gropings towards improvement were going on, simultaneously with investigations into photography, that the idea arose as to the possibility of producing, photographically, a printing surface of *relievo* and *intaglio* parts, instead of a mere picture made up of lights and shades. This led to the abandoning of etching or biting in with acid, and the substitution of a new photographic coating adapted for finally obtaining impression surfaces. The results of Mr. Pretsch's labors, as far as they have yet advanced, are now before us. They consist of a set of impressions from plates produced entirely by what the inventor calls "galvanography," the largest size we have seen being 16 inches by 12 inches. The subjects are various, including both architecture and the figure; and, as examples of plates made ready for the printer's hands, without a single touch of the graver, they are far beyond mere curiosities; indeed, they may fairly be classed with good calotypes, or well-finished sepia or indian-ink pictures of the artist, and in beautifully minute accuracy, far outrivaling all that can be produced by the unaided hand of man.

The primary steps of this photo-galvanographic process, are similar to those adapted to the glass-plate photographer. The operator coats a glass plate with a gelatinous solution, suitably prepared with chemical ingredients sensitive to light. This gelatinous matter consists of clear glue, with a strong solution of nitrate of silver, and a weak solution of iodide of potassium. To another portion of the glue solution, there is added a strong solution of bichromate of potass. These two compounds mixed together, form the coating material, which is allowed to dry upon the glass or other plate which is coated with it. When dry, the coated plate is exposed to the light in a copying frame, in contact with the print or drawing which is to be copied; or the camera may be used for a similar purpose. After exposure, the plate exhibits a faint picture on the smooth surface of the sensitive coating, and it is washed either with water, or a solution of borax, or carbonate of soda, when the whole image comes out in relief, whilst the tints of the original are still maintained. When sufficiently developed, this *relievo* plate is washed with spirits of wine, dried, and treated with copal varnish diluted with oil of turpentine. When dry, the plate is immersed in an astringent solution—as tannin, for example. This treatment, aided by heat, brings out the picture in full relief, ready for being copied for the production of the actual printing

plate. If the matrix plate is prepared for electric conduction, it may itself be placed in the electrottype battery, producing an intaglio copper plate; or, if first moulded, the intaglio mould furnishes the means of obtaining a relievio plate by electro-deposition in a similar way. The stereotype process also affords another means of producing the necessary plate. If an intaglio plate is made, it may be printed from at the common copper-plate printing press; on the other hand, the relievio plate may either serve as the matrix for producing an intaglio printing plate, or it may be itself employed in "surface" printing, like a wood-cut. In the latter case, the narrow impression lines being sufficiently raised, the broad white spaces must be cut out.

By another modification of the process, the gelatinous coating of the image plate is washed with spirits of wine, and then dried, when the picture is produced in intaglio, or sunk. Or, by applying printing ink to the coating, an ink impression may be taken for transference to stone or zinc, to print from in the usual way.

The examples of Mr. Pretsch's productions, to which we have referred, are quite sufficient to show us that the delicate beauty of original photographs need no longer be restricted to the actual picture which the camera gives us; nor need we be driven to the slow process of copying by negative pictures for the production of what are, at the best, but inferior counterparts of the original. The beautiful art of the photographer is thus rendered far more practically and enduringly valuable than it has hitherto been.

The impressions from the photo-galvanographic plates exhibit a tint much superior to mezzotints or aquatints, whilst whatever touches appear in nature are reproduced at the printing press with a fidelity which no artistic labor can rival. We know, too, how very liable photographic originals are to change; and in a series of copies from the same negative, there is always a want of uniformity in the shade of color. With this printing process, however, we are independent of such drawbacks, as the plate impressions are in ink, and the attention of an ordinary printer suffices to keep the pictures to the proper color.

The rapidity with which the plates can be produced, is another important and remarkable feature of the invention. From three days to three weeks, according to the special kind of work in hand, is time enough for the production of finished plates, some of which—as for example, those from photographic originals—the human hand could never engrave; or if imitated by manual engraving, would require even years of unremitting labor. The process, too, affords the means of obtaining exact counterpart plates, so that where extreme expedition is an object, several printing presses may be at work simultaneously, all producing exactly similar impressions. In all cases the artist's original designs are reproduced without the alteration of a single line or touch, and on any scale, so that the cartoons of Raphael at Hampton Court could all be quickly put on printing plates of a size suitable for a pocket volume.

An influential company has been formed in this country for carrying out the objects of the invention on a large commercial scale.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, May 15th, 1856.

John P. Park, President, pro tem., in the chair.

John F. Frazer, Treasurer.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Donations to the Library were received from the Geological Society, London; Hon. Job R. Tyson, U. S. Congress; Thomas U. Walter, Esq., Washington City, D. C.; Capt. Wm. H. Emory, U. S. Topographical Engineers; The Kentucky Mechanics' Institute, Louisville, Kentucky; George Bruce, Esq., City of New York; and Prof. Jas. A. Kirkpatrick, Philadelphia.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer read his statement of the receipts and payments for the month of April.

The Board of Managers and Standing Committees reported their minutes.

Candidates for membership in the Institute (5) were proposed, and the candidates proposed at the last meeting (3) were duly elected.

Mr. Howson exhibited specimens of sodium, chloride of aluminum, and aluminum, manufactured by Mr. Alfred Monnier, chemist and metallurgist, of Camden, New Jersey; who has been assiduously engaged in experimenting upon the production of the above materials during the past year, with the object of reducing the expense of manufacturing the new metal aluminum.

Professor Frazer explained to the meeting the process of manufacturing this metal.

He alluded to the purity of the clay, which had been procured from Woodbridge, near Amboy, N. J., and from which the specimens of aluminum exhibited, had been extracted; that this clay was very white, and contained very little iron, as illustrated by the whiteness and purity of the preliminary preparation, alumina. He also said that the specimens of sodium, and chloride of aluminum, were more beautiful and in greater mass than he ever saw before.

Of the specimens of sodium especially, the Professor spoke in very high terms; alluding to the process of manufacturing, the same adopted by Mr. A. Monnier, who had succeeded in preventing the destruction of the apparatus employed in its manufacture, an evil which had hitherto formed a most serious obstacle to its production in any large quantities.

He also alluded to the continuous process of manufacturing sodium, adopted by Mr. A. Monnier, and compared its advantages over the ordinary process to those of the perpetual limekiln over those of ordinary construction; and that he was satisfied that if the sodium could be produced at a moderate cost, as appeared probable from Mr. M.'s statements, it would be of immense advantage to arts and manufactures. The specimens of aluminum, was, to all appearance, remarkably pure, and superior to that imported from Paris; and might eventually be manufactured in

such quantities, and at so low a price, as to be used in the construction of an endless variety of useful articles.

Mr. Howson, also, exhibited a working model of W. B. Coates' patent apparatus for cutting standing stalks or bushes of hemp, corn, sugarcane, and cotton bushes. This machine will be found minutely explained and illustrated in the present number of this *Journal*, under the head of "Mechanical Engineering as applied to Farm Implements."

Mr. H., also, exhibited a beautifully finished full sized model of a safety feed and blow-off apparatus for steam boilers, for which a patent was lately granted to Mr. Frick, of this City.

A full illustrated explanation of this ingenious and efficient contrivance, will be given in a future number of this *Journal*.

Washington Jones exhibited some specimens of manilla hemp, in which the fibres were over five feet in length, and very fine; also, some of the same material, grown at Tampico, but having a shorter and coarser fibre. Much of the latter is used in the manufacture of scrubbing and sweeping brushes, for which it seems well adapted, being cheaper than bristles and much stiffer. After undergoing the process of curling and baking, it is used as a substitute for the hair in mattresses; and seems to be a better article for the purpose, particularly on shipboard, as no unpleasant odor can arise from it should it get wetted.

Dr. Turnbull brought to the notice of the Institute, the new "Police and Fire Alarm Telegraph." He exhibited one of the signal boxes, and made the following remarks:

The Philadelphia Police and Fire Alarm Telegraph is now complete, and in working order, extending through a hundred miles of streets, having 24 offices, and over 80 alarm stations. But few telegraph lines of equal extent in the United States, have cost so small a sum, and are so well built, the whole expense not exceeding \$33,000. Its utility in case of a conflagration has already been tested with the most gratifying results, also its usefulness in restoring lost children and property. In case of riot, the police can be concentrated and brought to the scene of strife, thus nipping it in the bud. As the telegraph has become a matter of general interest to the public, the following facts in relation to it have been collected, in order to give the Members of the Institute an idea of the nature of its operation. It was constructed under the contract with Messrs. Philips & Robinson, each having given it his immediate supervision. The Police and Fire Alarm Telegraph, are, while combined, yet distinct, each being complete in itself.

The "Police Telegraph," consists of three distinct circuits or lines of wires, dividing the city, for police purposes, into three sections. All the stations in each section or circuit, being connected with each other as well as with the central office.

The instruments used are very simple, and within the capacity of almost any one who can read and write, yet fully adequate for the transmission of any business which may be required of them. Each police office or station is provided with a magnet and alarm bell—by which they are called—and also the telegraph instrument, which has a dial, on which are marked the letters of the alphabet, and the numerals from 1 to 0. In the centre of the dial, is a hand or pointer, like that on the

dial of a clock, which hand is thrown forward one letter each time the circuit is broken. This is done by means of a single key, which on being pressed down, breaks the connexion between the wires, and on being released springs up again, always insuring a closed circuit when not in actual use; thus guarding against negligence. Suppose the word (cent) is to be written, the operator writing strikes his key rapidly thus repeatedly opening and closing the circuit until the indicator or hand has been thrown forward to the letter or figure he wishes to designate, in this case the letter C, then pauses an instant; this has thrown the hand on the dials (his own as well as the receiving offices) forward, thus: A B C; he then goes on two strokes, and a pause, D E; again nine strokes, F G H I J K L M N; O P Q R S T. Again 7 strokes U V W X Y Z &. The capitals show the pauses, and the character, &, shows the end of the word, and is also the starting point. A large proportion of the ordinary set phrases in daily use, are arranged to be given by a combination of numerals. Thus, 32S, "Who is in charge of the station house?" Reply, 359, "The Lieutenant is in charge;" or, 362, "The First Sergeant."

Again, 976, "Are there any indications of riot in your District?" To which is replied, 4, "Yes," or 7, "No." These can be given by the bell, or on the figures on the dial; thus expediting the operations very much in the every day business of the telegraph. The wires of the Fire Alarm Telegraph, are, as we said, distinct from the police, and form a sort of net-work over the built-up portion of the City; with signal boxes or stations at points convenient of access, which boxes contain an apparatus so simply arranged, that an alarm can be given by any one who can reach the box. The only operation consisting in moving a small brass button, which extends through the inner case, from right to left, through an opening in the case about three inches in length. The direction in which it is to be moved is indicated by a dart, and is the only way it can be moved. The person who has thus moved it, lets go of it. He has by this movement wound up a spring, and at the same time set in motion a train of clock-work, which carries the apparatus necessary to communicate the alarm to the central office (State House).

Each box in the City is numbered, and in running down after being set in motion as described, strikes on a small bell at the central office its own number, and at the same time records it on a slip of paper, connected with an improved Morse instrument peculiarly adapted to this purpose. The alarm thus received is at once communicated to the State House Steeple, and to all the station houses, and at the same time the number of the box giving the alarm is struck on a small bell which is contained in each of the boxes.

Thus, a person in Richmond is desirous of knowing the precise locality of the fire.

When the State house bell is striking the district he goes to the box nearest him, and hears four strokes on the bell, and a pause followed by a single stroke, meaning 41. He then ascertains that the fire is in the vicinity of Third and Market Streets (41 being the number of the box at that corner).

A speaking tube connects the Mayor's Office with the central telegraph office, to be used in sending orders to the different station houses, receiving

answers and other police communications; and a similar one is put up between the central office and the bell ringer's apartment in the State House steeple, so as to give intelligence of fires the instant it is received from any portion of the City.

The line, it is conceded by all acquainted with telegraph business, has been constructed in the best possible manner, every attention having been paid to the smallest details, while the prominent features of the work are carried out in excellent style. It has been placed in competent hands, Mr. William J. Philips, the newly elected Superintendent being known as one of the most capable, efficient, and talented operators of the present day.

COMMITTEE ON SCIENCE AND THE ARTS.

Stated Meeting, May 8th, 1856.

Dr. B. H. Rand, Chairman, pro tem.

Sub-committee appointed.

No. 696.—To examine Wm. F. Brooks' process for Manufacturing Seamless Metallic Tubes.

Reports of sub-committees read.

No. 677.—On Ignition of Saw-dust at a low temperature in the Factory of Joseph Elkinton & Son; recommitted at request of chairman of sub-committee.

No. 682.—On Linus Yales' Locks and Iron Doors and Shutters, read first time, and laid on the table.

No. 684.—On Louis Rossett's Twin Articulation Boat.

" 688.— " John Tremper's Pneumatic Rotary Governor.

" 693.— " H. Whitall's Moveable Planisphere.

" 694.— " Prof. W. Chauvenet's Great Circle Protractor.

The above reports having passed the second reading were adopted; and Nos. 688, 693, and 694, referred to the Committee on Publications.

COMMITTEE ON SCIENCE AND THE ARTS.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, "A Great Circle Protractor," invented by Professor W. Chauvenet, Annapolis, Maryland—REPORT:

That the object of the instrument is to give to navigators a simple and accurate mode of laying down upon their charts, the great circle of the earth, which passes through their points of departure and destination, and is known to be the shortest distance between those points over the surface of the earth. Now, if such a line be drawn upon the surface of a celestial globe, it will be seen that it does not make equal angles with the successive meridians—and its course cannot easily be laid down upon

the ordinary charts (Mercator's) without elaborate calculations, or the use of some auxiliary instrument such as we have now under notice.

The Protractor of Professor Chauvenet, consists of a stereoscopic projection of the sphere of moderate size, upon which are laid down the meridians, and parallels of latitude for every degree. The degrees of longitude being numbered along the equator both ways, so that the circumference of the chart may be taken to represent the meridian of the point of departure, and the difference of longitudes between that and the point of destination, will indicate the position of this latter place by the chart. The parallels are numbered as usual from the equator, and hence the position of any point is marked upon this chart in its true latitude. Above this fixed chart, is a movable one printed upon a transparent material, and for the sake of clearness, in differently colored ink. But, the points corresponding to the poles in the fixed chart are here marked as the east and west points of the horizon, and the middle line of the curves passing through these points (the meridians of the ordinary chart,) is called the line of distances, while that line which corresponds to the equator is marked as the line of courses, and its extremities labeled N. and S. It will now easily be seen, that if the upper sheet be so turned, as to bring its east or west point to correspond with the position of the point of departure, as indicated upon the lower chart by its latitude, (it is to be remembered that its longitude is to be taken as 0, that is, it is to be taken on the margin of the chart,) and the position of the place of destination be also marked upon the chart, by its latitude and difference of longitude from the first, then one of the curves of the upper chart will be seen to pass through or near this place of destination, and such curve is the great circle of the earth which joins these two points upon the sphere. The latitude in which this curve crosses each successive meridian may be easily read off through the upper paper, and being marked upon the ordinary Mercator chart, will allow the proper course of the vessel to be easily and rapidly traced. If the curve be followed to the line of courses (or equator of the upper chart,) the corresponding graduation indicates the direction in which the vessel is to be headed at starting, and as often as this may be done during the voyage, using the ship's position at any time as the starting point, so often may the proper course for the vessel be determined. The parallel of the transparent chart, which passes through the point of destination is the circle of distance, and by following this down to the line of distances, we find recorded the number of degrees of arc, (or by multiplying this number by 60, the number of nautical miles,) intervening between the points of departure and destination.

It is obvious, moreover, that this arrangement of charts affords an approximate solution of all cases of spherical triangles, and may thus be used by navigators as a rough check upon their calculations.

Simple as this instrument is, it has long been a desideratum in nautical science, and has been sought for with great labor and anxiety by ingenious mathematicians and practical men; heretofore without success, until Prof. Chauvenet has furnished the present simple and practical solution which seems to leave nothing to be desired either as to simplicity or accuracy.

The Committee, therefore, believing the contrivance to be entirely new, and highly ingenious, and in consideration of its practical value, recommend that the Scott Legacy Premium be awarded to Prof. Chauvenet for his invention.

By order of the Committee,
Philadelphia, May 8th, 1856. WM. HAMILTON, *Actuary.*

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, "an Improved Movable Planisphere," invented by Henry Whitall, of Philadelphia, Pennsylvania—REPORT:

That it consists of a map of the heavens projected upon the plane of the equator, the margin being divided along its circumference into months and days, and movable within a fixed border which is itself divided into the hours of day and night. Around the position of the North Pole as a centre, is movable an elliptical rim performing the part of the horizon, and divided into the various points of the compass; which rim is crossed by a meridian band, graduated into degrees of latitude extending on the one side 40° below the equator, on the other 50° from the pole. This rim or horizon is made elliptical to accommodate the map to variations in the latitude of an observer—and obtains this convenience at the expense of a scarcely perceptible error in the time of rising, and position of the stars. Now, if this planisphere be set, by bringing the proper day of the month to the noon-mark on the outer rim, and by bringing the index or southern point of the horizon to any required time of night, the portion of the map included within the bounds of the horizon will represent faithfully the visible heavens at that moment, or by bringing any given star to the eastern or western point of the horizon, the position of its rising and setting may be observed, while the index will indicate the time of this phenomenon, with an accuracy quite sufficient for general observations.

It will be seen, then, that the instrument furnishes a cheap portable and sufficiently accurate substitute for a celestial globe or a series of charts—and will be found very convenient for persons who desire to become familiar with the constellations, or to watch atmospheric phenomena, such as meteors, and note their apparent places and paths. Especially by persons desirous thus to occupy their time while away from their usual residences, will this neat contrivance be appreciated. The examination of the Committee have satisfied them that the map itself is quite sufficiently accurate in its places of the stars, for the purposes designed—and unhesitatingly express the opinion that it is deserving of commendation and patronage.

By order of the Committee,
Philadelphia, May 8, 1856. WM. HAMILTON, *Actuary.*

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